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NATIONAL GEOGRAPHIC

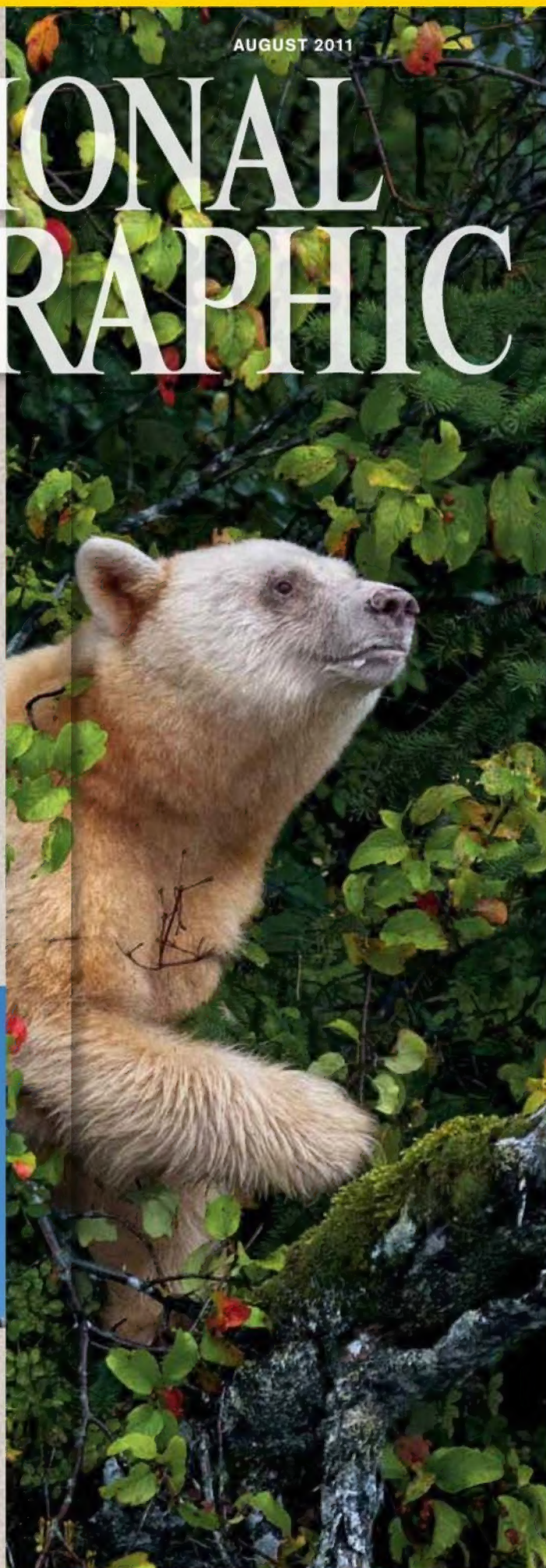
The
**Wildest
Place**
in
AMERICA

Land of the
SPIRIT BEAR

**Making
Robots
HUMAN**



**South Africa
Fossil Find
A MISSING LINK?**



The 2011 Guide to Automotive Advancements

Electric Vehicles, Hybrids, Plug-in Hybrids and Fuel Cells – How to Navigate New Driving Technology

By M. Desmond Roth

The numbers drive home the stakes: by 2035, there will be an estimated 1.6 billion cars on the road throughout the world.¹ If every one of these cars was fueled by a gas engine, CO₂ emissions would reach an estimated 8.2 billion metric tons per year.²

Yet it's been estimated that if every one of those cars was powered by hybrid technology, combining an electric motor with a gas engine, those emissions could be cut nearly in half.³

Scientists today can agree that reducing gas consumption and relying on alternative fuel technology are critical to reducing greenhouse emissions and stabilizing the climate.

At the core of the latest advances is hybrid technology, which forms the foundation for next-generation cars powered by electricity, hydrogen and biofuels.

The Next Big Thing: Plug-in Hybrid

There will soon be a hybrid for nearly every driver's needs as costs and performance metrics compete with conventional gas engine vehicles. Toyota is launching 11 different hybrid models globally in two years starting from 2011, seven of which will be all-new, not merely the next generation of an existing model.

Going one step further is the Prius Plug-in Hybrid (PHV) which is currently the subject of an international 600-vehicle demonstration

program which began about a year ago and will run until the vehicle goes on sale approximately this time next year.

Offering the latest technological innovations of the current Prius, the Prius PHV currently being demonstrated adds a high-capacity lithium-ion battery that enables the vehicle to travel up to 13 miles on electric energy only, and can be recharged by plugging into a standard 110v home electric outlet or a 220v charging station. The Prius Plug-in can operate in all-electric mode at highway speeds of up to 60 mph, producing zero emissions during

short commutes. When the EV-only portion of the battery is drained of power, the vehicle defaults into Prius-mode, with conventional hybrid gas-electric power delivery and a combined fuel economy of approximately 50 mpg.⁴

Emissions-Free in EV Mode, Stress-Free in Hybrid (HV) Mode

The Prius Plug-in Hybrid demonstration vehicle can be fully recharged with a household electric outlet of 110v in just 3 hours. With a 220v outlet, it takes just one and a half hours to fully recharge – ultimately allowing for emissions-free driving in EV mode and stress-free driving during out-of-town weekend trips in HV mode.

Now imagine driving an SUV that can drive 430 miles⁵ per fueling, and releases nothing more than water. That's what current U.S. test drivers are experiencing

with the Fuel Cell Hybrid Vehicle (FCHV-adv).

Relying solely on batteries and hydrogen, the FCHV-adv car is powered by the electrical energy created by the chemical reaction between hydrogen and oxygen, which forms zero-emissions water vapor that is passed out the tailpipe.

"It's no longer a question of will these plug-in and hydrogen vehicles happen or not. It's about how quickly the market will grow, and how big their numbers will get," says Tim Lipman, co-director of the University of California - Berkeley's Transportation Sustainability Research Center (TSRC).

Toyota plans on launching its fuel cell model no later than 2015, once all testing of safety and reliability features are complete.

Not Just Greener – Better

While the ecological benefits of the Plug-in Hybrid and Fuel Cell

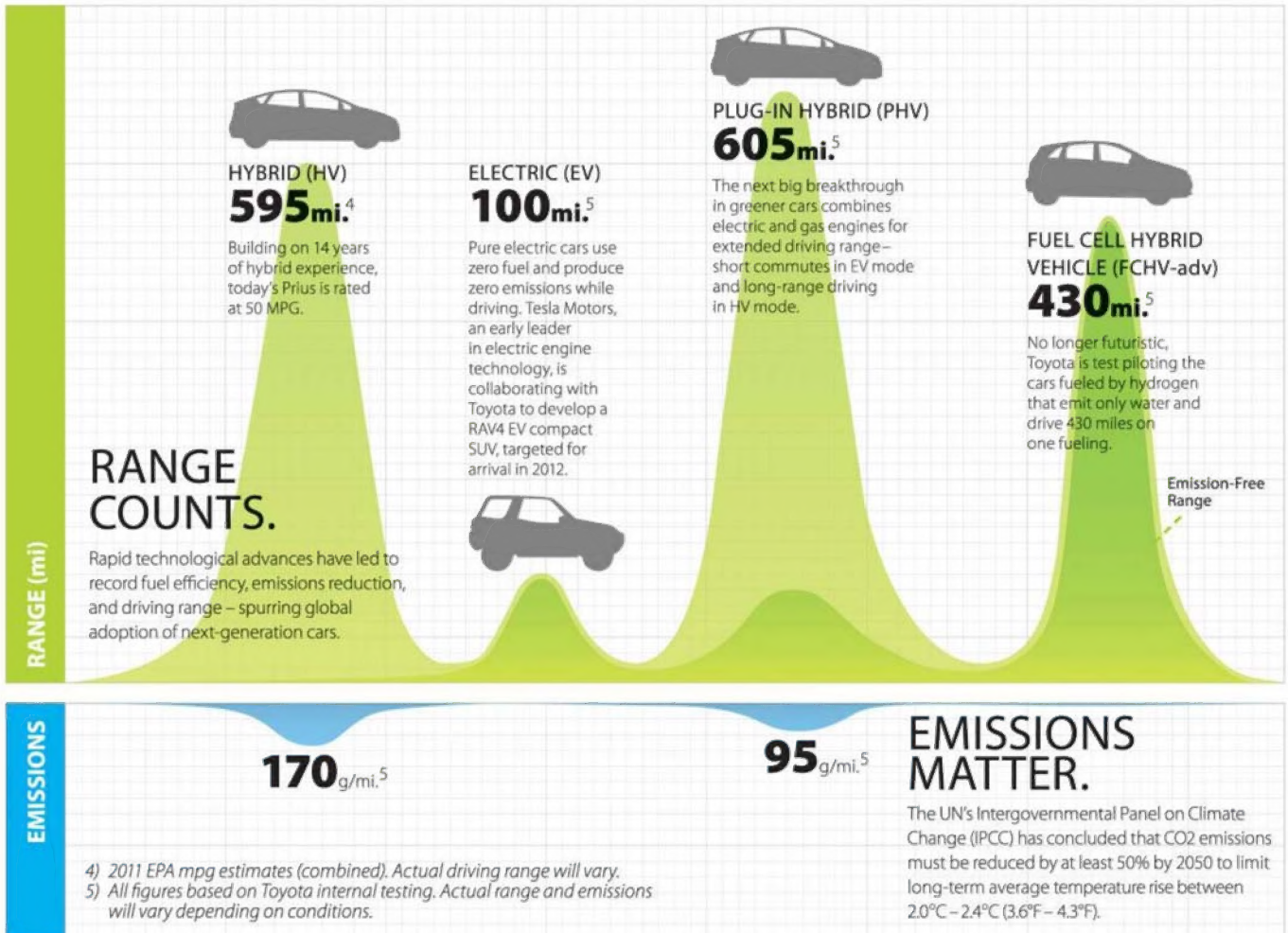
Hybrid Vehicle are generating excitement among environmentalists and government officials, the technology and practical advantages are helping build enthusiasm among test drivers around the world.

"Our studies tend to show that once people are exposed to these next-generation cars, their general impressions go up," says Lipman, who oversees a pilot program for the Prius Plug-in Hybrid and Fuel Cell Hybrid Vehicle.

After experiencing the fuel efficiency, quiet engines and smooth acceleration, test drivers report that the cars are not just greener – they're better.

"There's a market segment that will buy a clean car, but a much bigger market segment will buy a better car. That's where the prospects are good for these greener cars."

continue >>



Graph shown for illustrative purposes only.

The Road Ahead: Meeting the Needs of

It may be hard to imagine, but over a century ago, sales of electric vehicles outstripped gas-driven car sales in the U.S.

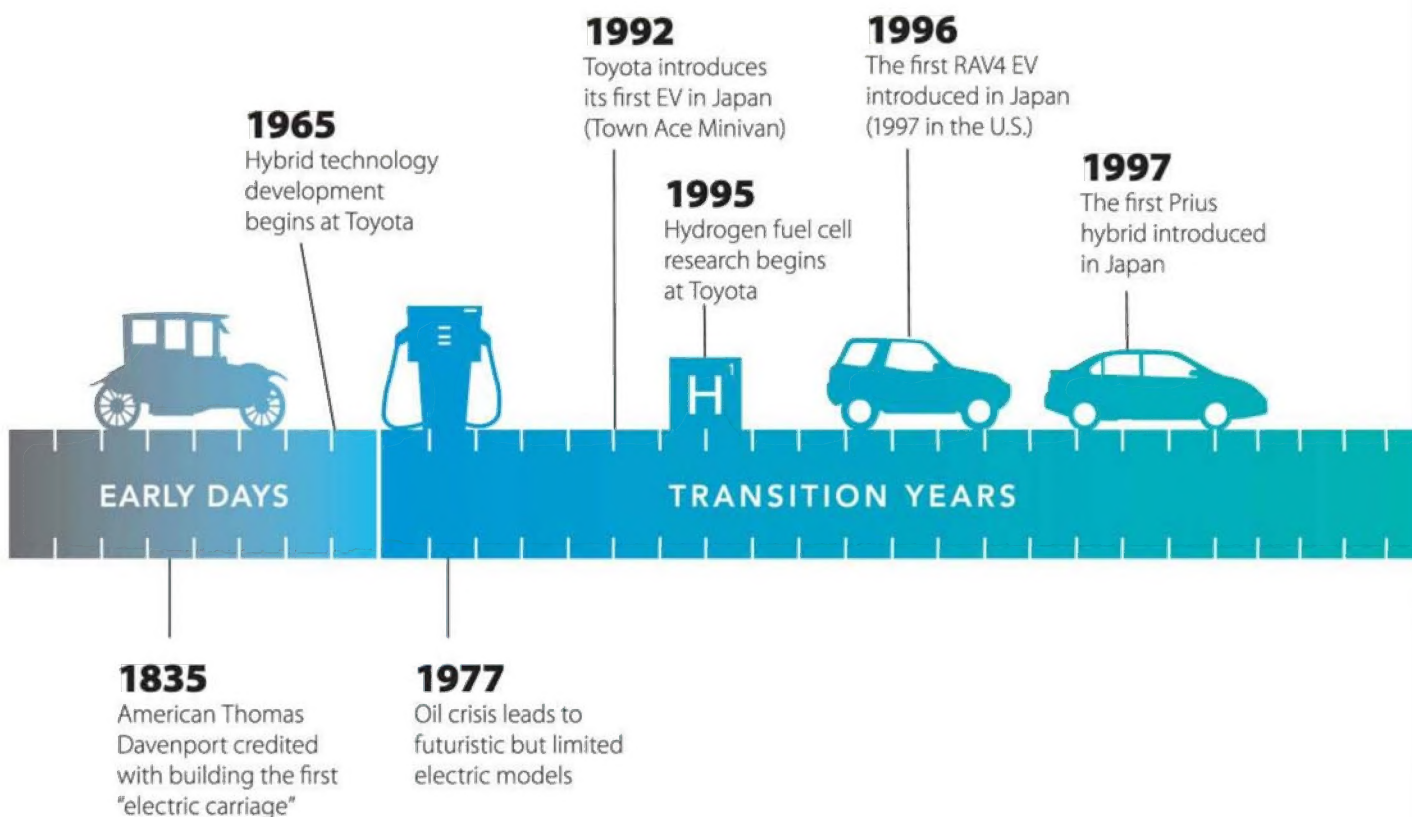
At the turn of the 20th century, as many as 30,000 electric cars took to the roads, including a fleet of New York taxis. But when mass production of petroleum cars

began in the early 1900s, electric cars simply couldn't compete. Gas-fueled cars cost half as much and could travel further and at faster speeds.

It would take six decades before electric cars would make their comeback, driven by the oil crisis of the 1970s, which set in motion two decades of experiments and futuristic new model launches. But the cars all came with limitations and costs that prevented them from catching on.

It wasn't until 1997, when the first Prius hybrid rolled onto the streets of Japan, that a practical eco-conscious car finally arrived. By bridging the gap between

The Evolution of Greener Cars:



SOURCES: 1) International Energy Agency (IEA). World Energy Outlook 2010, "Policies Scenario." Estimate is for total "passenger light-duty vehicles" on the road worldwide. 2) U.S. Environmental Protection Agency (EPA) estimates 5.10–5.20 metric tons CO₂ per vehicle-year for the average vehicle on the road today. Calculation: 1.6 billion cars multiplied by 5.15 metric tons equals 8.2 billion metric tons. 3) Estimates based on U.S. De-

Tomorrow's Driver

electric and gas engines, the Prius became an immediate hit – selling more than 100,000 units with its first model and reaching the two million mark by 2009. The car soon became an international symbol of environmental progress.

Today, the electrification of the passenger car is moving rapidly in many directions. Recent advances in lithium-ion battery technology have helped re-launch electric cars. Tesla Motors, an early leader in

electric engine technology, is collaborating with Toyota to develop a RAV4 EV compact SUV, targeted for arrival in 2012.

Clearing the Horizon

In the end, in order to meet international fuel efficiency standards, "there has to be a massive global adoption of hybrids," says Bradley Berman, editor of HybridCars.com. For mass adoption to happen, consumers must have choices that are accessible and meet their daily needs.

Building on 14 years of advances in hybrid car technology, Toyota continues to pioneer the technological advances that expand choices to meet the needs of all people. The company's complete range of hybrid technology is at the core of plans to create eco-conscious cars across its lineup, each one moving us further away from dependency on gasoline, and each one improving the air we breathe. That will mean a clearer horizon for everyone.

A Timeline

2002

First hydrogen fuel-cell hybrids are leased in Japan and the U.S.

2010

Tesla teams up with Toyota to produce electric cars

2011

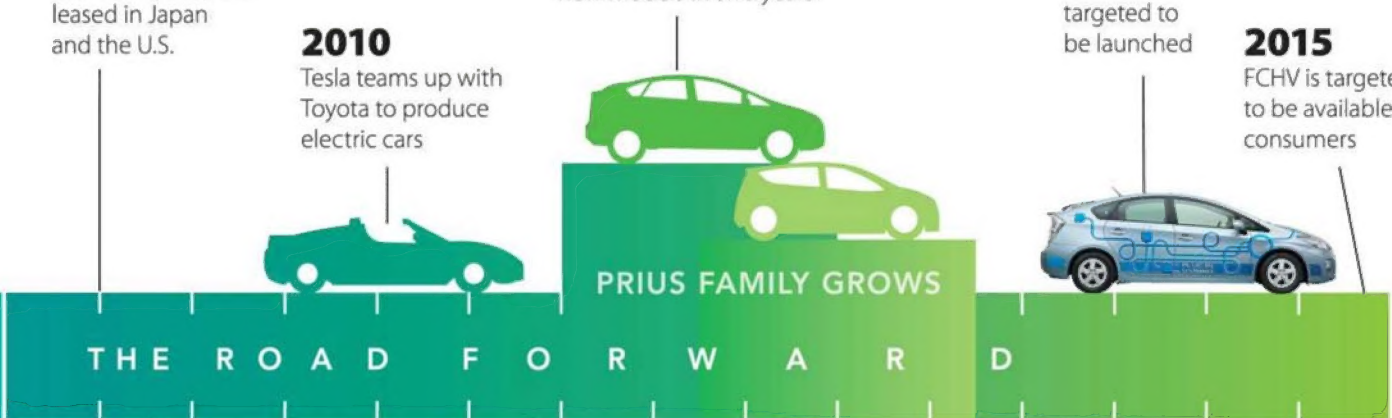
Toyota hybrid lineup is expanded with release of 11 new models in two years

2012

Prius Plug-in Hybrid vehicles and Toyota electric vehicles are targeted to be launched

2015

FCHV is targeted to be available to consumers



1,000,000

2007

One million hybrids sold worldwide

2,000,000

2009

Two million hybrids sold worldwide

3,000,000

2011

Three million hybrids sold worldwide

partment of Energy (DOE), Argonne National Lab, GREET 2010 figures. 4) 2011 EPA mpg estimates (combined). Actual driving range will vary. 5) All figures based on Toyota internal testing. Actual range and emissions will vary depending on conditions.

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Yellow-eared Parrot (*Ognorhynchus icterotis*)

Size: Head and body length, approx. 42 cm (16.5 inches) **Weight:** Approx. 285 g (10 oz)

Habitat: Humid montane forest in the Andes of Colombia **Surviving number:** Estimated at 1,100



Photographed by Roland Seitre

WILDLIFE AS CANON SEES IT

A very particular parrot. The yellow-eared parrot roosts and nests in one place and one place alone: the wax palm tree. With the wax palm as its home base, the boldly beautiful bird ventures out to find fruit, bark and buds to eat. A male and female form a breeding pair while a third bird, called a brood-helper, often assists the couple in feeding and caring for their chicks—an unusual behavior among parrots. While populations had

dwindled to just 81 birds by 1998, this parrot has recovered to some extent since then. But with its only suitable habitat suffering severe fragmentation, it is still in particular danger.

As we see it, we can help make the world a better place. Raising awareness of endangered species is just one of the ways we at Canon are taking action—for the good of the planet we call home. Visit canon.com/environment to learn more.

Canon

NATIONAL GEOGRAPHIC



iCub crawls, sits up, and apes human expressions. Made in Italy, it is used to study how robots interact with their surroundings. Story on page 66.

MAX AGUILERA-HELLWEG

August 2011

34 Spirit Bear

The wildest place in America is home to the unlikelyst of creatures: a white black bear.

By Bruce Barcott

Photographs by Paul Nicklen

54 Pipeline Through Paradise

In the Great Bear Rainforest a tanker war has begun. It's going to be a bare-knuckle fight.

By Bruce Barcott

66 Robots Get Real

They can now serve drinks, act as companions, and look like us. Are we ready for them?

By Chris Carroll

Photographs by Max Aguilera-Hellweg

86 A Multitasking Monkey

India's langurs stand guard at public events, have holy status—and can also be a bit pesky.

By Jennifer S. Holland

Photographs by Stefano Unterthiner

96 Land of Shadows

As it comes out of isolation, the nation of Myanmar is caught between darkness and light.

By Brook Larmer *Photographs by Chien-Chi Chang*

120 Part Ape, Part Human

A new ancestor emerges from the richest collection of fossils ever found.

By Josh Fischman *Photographs by Brent Stirton*

Art by John Gurche

CHASE 
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If being a royal honeymoon destination isn't enough, in March 2012 the Seychelles will host the "Carnivals des Carnivals," a gathering of the best of the best of this Creole tradition with floats and entertainment from around the world. The fun plays out on Mahé in the capital city of Victoria.

To help you get into the Carnival spirit, there's Chase Sapphire. Unlimited rewards and expert advisors who answer whenever you call will give you more reasons to celebrate.

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Palm trees in tropical Seychelles.

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DINE

The venerable **Marie-Antoinette** restaurant serves home-style Creole cuisine in a charming century-old home.

MAHÉ, TEL 248 26 62 22

Island hop—by catamaran—to Praslin for lunch at **Coco Rouge**, a simple spot with seriously good local fare.

BAIE STE ANNE, PRASLIN, TEL 248 23 22 28


SHOP

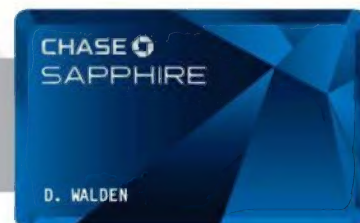
At the **Tea Factory** you'll see tea go from plant to process to teapot—and purchase samples such as Sey Té, a heady tea mix with hints of citrus, mint, and vanilla.

SANS SOUCI, MAHÉ, TEL 248 37 82 21

Amid the souvenir T-shirts at the **Craft Village** are sweet little Creole dolls, model ships, and other handmade local-culture items.

ANSE AUX PINS, MAHÉ, TEL 248 37 61 00

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18 **Your Shot**



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Gorillas at the Salad Bar ▶

They're giving up biscuits (right) for romaine to ward off heart disease.



The Moon's Inner Life

Instruments left by the Apollo astronauts tell a molten tale.

Pint Size(s)

Britain's classic beer serving will shrink a bit this year.

A Man, a Beetle, a Mission

A Nebraska entomologist strives to save a lowly bug.

Spotting the Leopard

Why are there so many coat patterns? See what digital data reveal.



28 **NEXT**

Banking on Blue Blood ▶

A horseshoe crab's vital fluid helps labs screen for pathogens.

Patents in Limbo

The U.S. office alone has a backlog of 1.2 million—from here and abroad.

Brain Delay ▶

Why is it so tough to identify the animal at right?

Speaking in Pictures

Illustrated pamphlets are invaluable for U.S. soldiers in Afghanistan.



E-GEOGRAPHIC

Here are the coolest extras on our electronic editions.

Robotic Soccer

Watch a team of two-footed robots try to master the art of kicking a ball into a goal. Humans, do not be afraid. The robots fall down a lot.
ngm.com + iPad

Hunting Bears

A video shows how photographer Paul Nicklen stalked the spirit bear.
ngm.com + iPad

Puzzling Inventions

Check out our quiz: Can you identify the objects in patent drawings?
ngm.com



On the Cover

This mama Kermode bear came out for a crab apple meal in Canada's Great Bear Rainforest. The harvest was so bountiful that she didn't bother fishing for salmon.
Photo by Paul Nicklen

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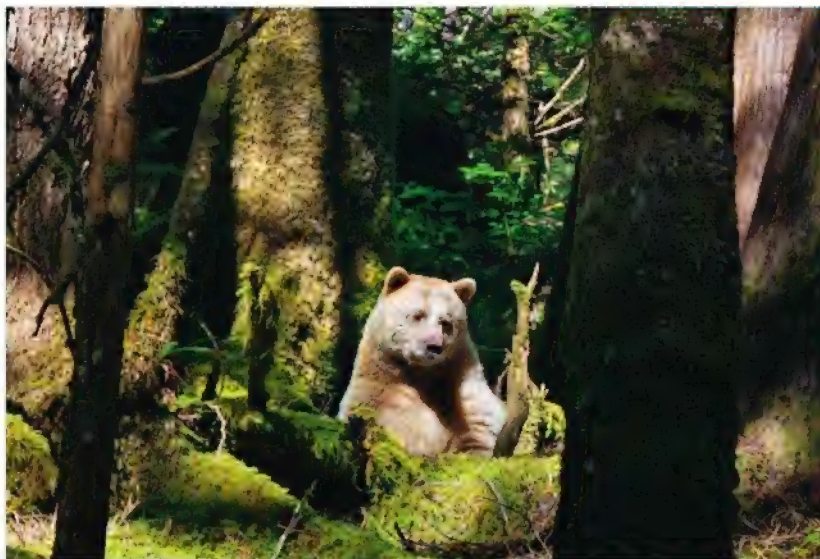
Rare Bear

When photographer Paul Nicklen proposed a story on spirit bears, I was skeptical. I had worked in British Columbia's Great Bear Rainforest 26 years ago and had heard about this elusive animal, but never came close to glimpsing one, let alone getting a photo. But I should never underestimate Paul. Not only did he photograph spirit bears, as the white-coated Kermode bears are known, but he also got close-up. In fact, he hung out with the big male (below) for two days. That was after going three weeks without a sighting.

Spirit bears are shy. Perhaps a thousand of them live in one of the largest coastal temperate rain forests in the world. When the bear showed up, it was like a gift. As the big male walked through scruffy second-growth forest, Paul wondered how he was going to photograph the animal in such ugly surroundings. Then the bear came to a magnificent old-growth western red cedar and went to sleep on a bed of moss at its base. The moment was powerful; it called to mind Paul's childhood dreams, in which he wandered through the forest with a bear.

Here's another thing about Paul: He's not afraid of controversy. In this issue's article "Pipeline Through Paradise," he and colleagues from the International League of Conservation Photographers cover a proposed plan to build an oil pipeline through the Great Bear Rainforest. "The beautiful bear used all layers of the ecosystem. He'd go to the estuary, eat grass, grab a salmon in the river, and walk through the forest," said Paul. This pipeline plan adds another layer to the story of spirit bears and to the challenges they face.

When the bear showed up, it was like a gift.



A male Kermode bear prepares for a nap on soft moss.

A handwritten signature in black ink, reading "Chris Johns".

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Genius of the Inca

I commend the work of Brian Bauer in uncovering the history of the Inca Empire and especially his efforts to restore the mummies of the Inca kings to the people of Peru. I did chuckle, however, when he asked how American citizens would feel "if the British had taken the bodies of the first several presidents back to London during the War of 1812." I imagine there would have been an outcry indeed, since Adams, Jefferson, Madison, and Monroe were all still alive and well in 1812. I appreciate Bauer's sentiment, but his analogy should have been limited to George Washington.

DENISE PINELL LEDER
Medford, Oregon

I have always wished to travel to Machu Picchu. Unfortunately I developed heart problems before I committed myself to go. When I finally asked my cardiologist if I could travel there, his reply was, "If you wish to stay there, go ahead." I now tell my family that when my final time comes, I will stop at Machu Picchu first, then turn to wave them goodbye.

JAMES E. ALEXANDER
Belleville, Ontario

I wonder if the laborers who built these Inca palaces had collective bargaining rights. My guess is that they had not much to say about it. I am always amazed at how little progress we have made. We continue to praise the accomplishments of the privileged while ignoring the people who actually produce the accomplishments.

MIKE KNAPP
Las Cruces, New Mexico

The Volcano Next Door

I was interested in the link between future eruptions and the impact on Goma. The work that Ken Sims is doing will aid understanding not only of Nyiragongo but also of other volcanoes that threaten people in developing countries.

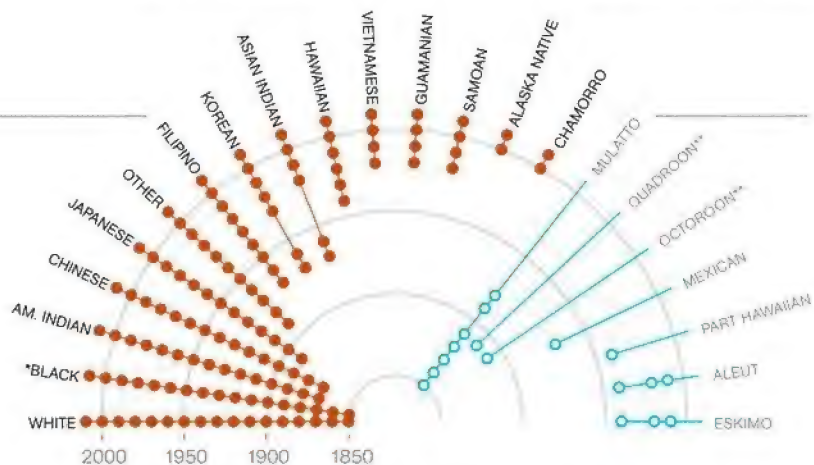
ALEXANDER COWAN
Victoria, British Columbia

I lasted only 15 months as a humanitarian aid worker in post-genocide Rwanda. I was overwhelmed by the devastation. Before leaving, I traveled through Goma to climb Nyiragongo, exactly two years after its 2002 eruption. Camping a few hundred feet from the rim, I awoke in the night to peer down into the caldera. It was like a glimpse into hell. The experience was a reminder that no matter how destructive humanity gets, we remain at the mercy of forces of nature.

NOELLE JOHNSON
Santa Rosa, California

FEEDBACK In April's article "Marrying Out," some readers took exception to our description of Barack Obama as "America's first black President," though Obama, who is of mixed race, self-identified as black on his 2010 census form. This graphic shows options available for racial identification on the U.S. Census since 1850.

● Currently in use ● No longer used

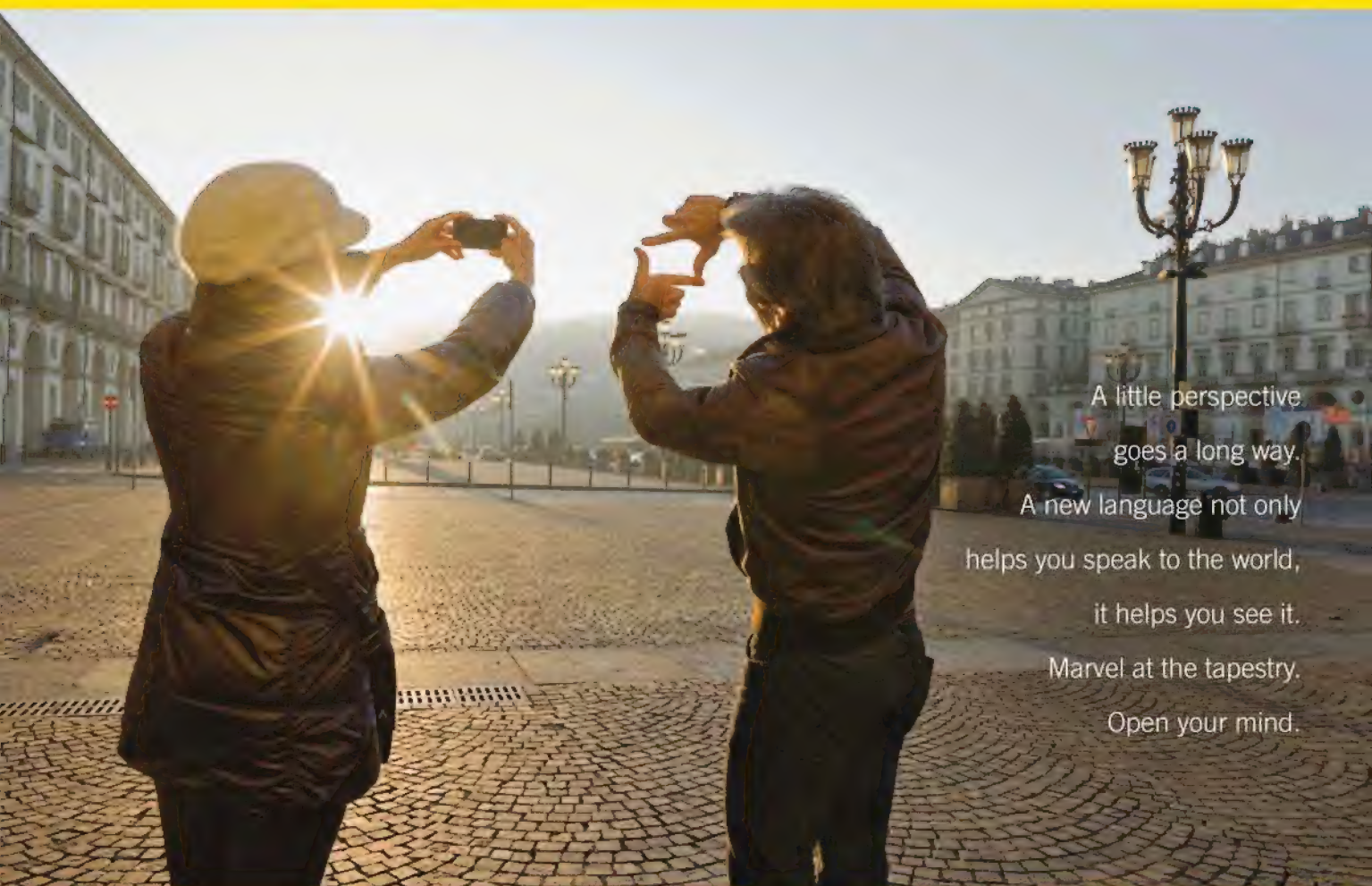


Race categories on the U.S. census since 1850, by decade



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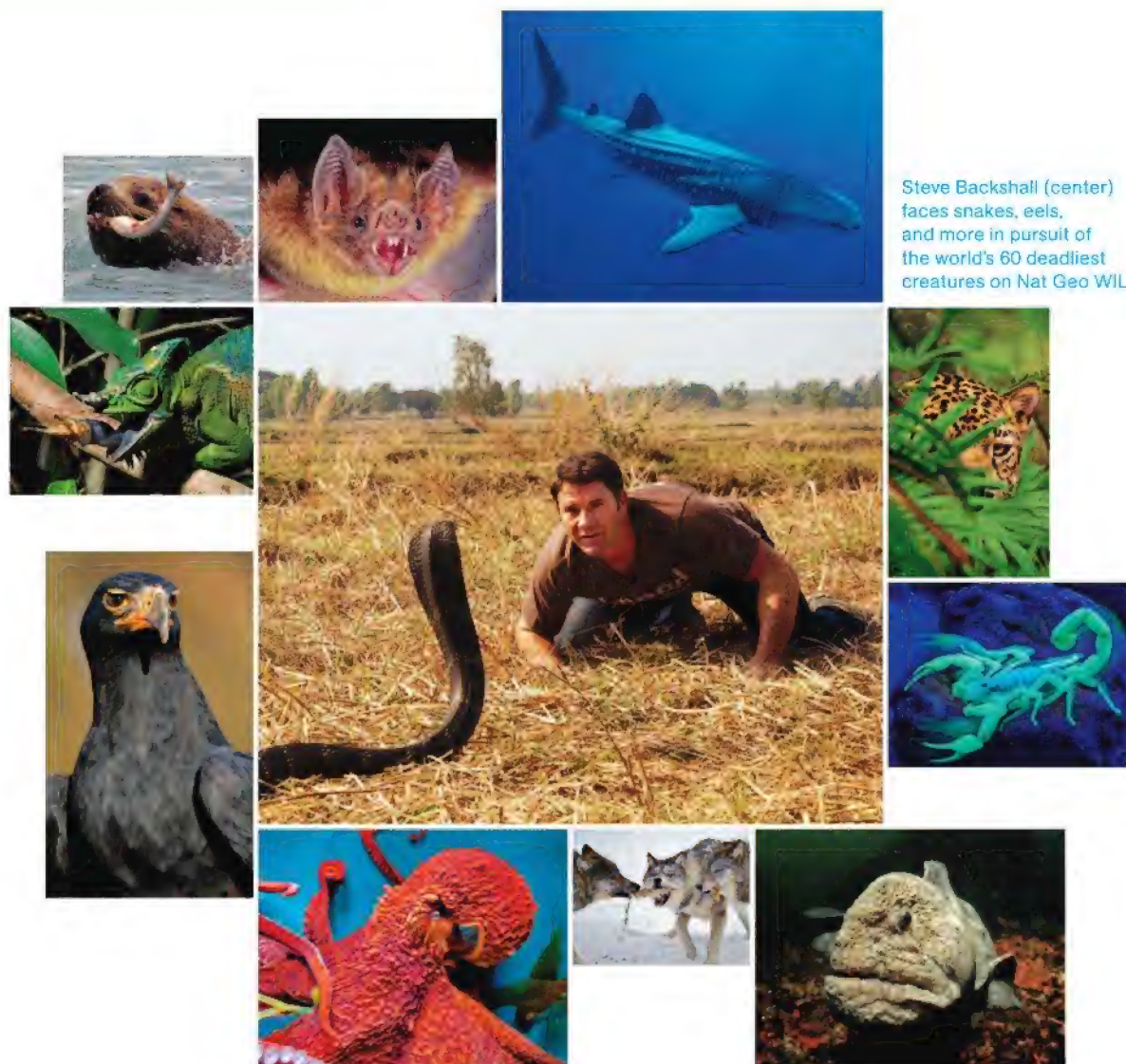
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Steve Backshall (center) faces snakes, eels, and more in pursuit of the world's 60 deadliest creatures on Nat Geo WILD.

Deadly 60

Sporting hooked claws, a paralyzing sting, and a metallic blue body up to two inches long, the tarantula hawk wasp—named for the spider it preys upon—is no joke. It's one of nature's nastiest hunters, yet Steve Backshall heads to Mexico's Baja peninsula to handle one in *Deadly 60*, a new series on Nat Geo WILD. Watch from the safety of your couch as he tracks down a host of predators, including Romanian wolves and Namibian vultures, and shows how their deadly techniques help them survive.

For listings go to natgeotv.com and natgeowild.com.



NATIONAL GEOGRAPHIC CHANNEL

Indestructibles The laws of physics help scientists explain how some people manage to escape death in dire situations.

CLOCKWISE FROM TOP LEFT: MICHAEL QUINTON, MINDEN PICTURES; MICHAEL AND PATRICIA FOGDEN, MINDEN PICTURES; NORBERT WU, MINDEN PICTURES/NATIONAL GEOGRAPHIC STOCK; FRANS LANTING, NATIONAL GEOGRAPHIC STOCK; ALBERT LLEAL, MINDEN PICTURES; JÜRGEN FREUND, MINDEN PICTURES; JIM BRANDENBURG, MINDEN PICTURES; VINCENT J. MUSI, NATIONAL GEOGRAPHIC STOCK; STU PORTER, ALAMY; NORBERT WU, MINDEN PICTURES; JOHNNY ROGERS, BBC
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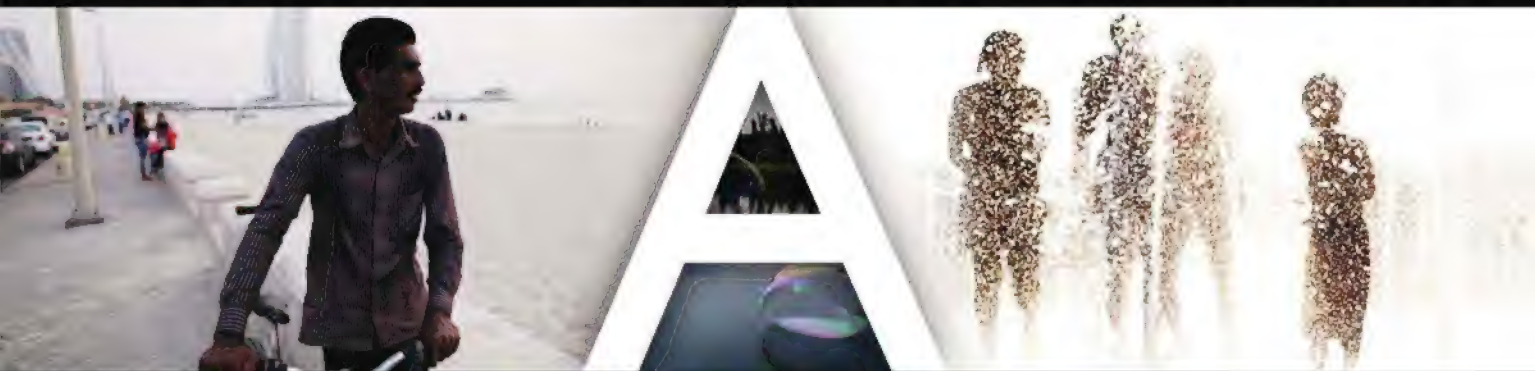
PRODUCED BY RIDLEY SCOTT • DIRECTED BY KEVIN MACDONALD

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—THE INDEPENDENT



What happens when you send a request out to the world to chronicle, via video, a single day on Earth? You get 80,000 submissions and 4,500 hours of footage from 192 countries. Producer Ridley Scott and Oscar-winning director Kevin Macdonald took this raw material—all shot on July 24, 2010—and created *Life in a Day*, a groundbreaking, feature-length documentary that portrays this kaleidoscope of images we call life. Beautiful and poignant, heartbreaking and humorous, the film ultimately shows us that we are all connected in ways we never imagined. National Geographic Entertainment is proud to be the U.S. distributor of *Life in a Day*. Look for it at a theater near you starting July 24. Prepare to be amazed.



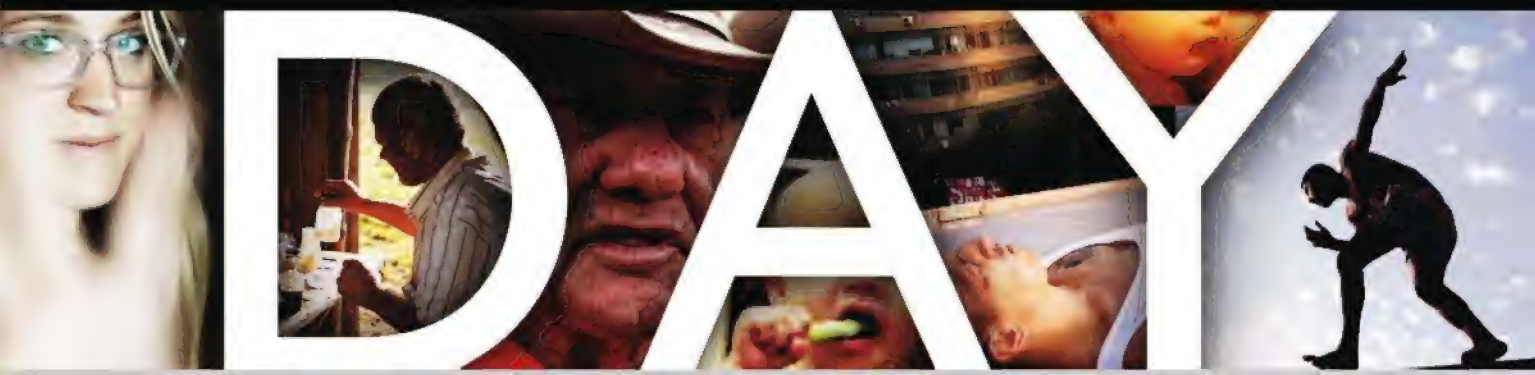
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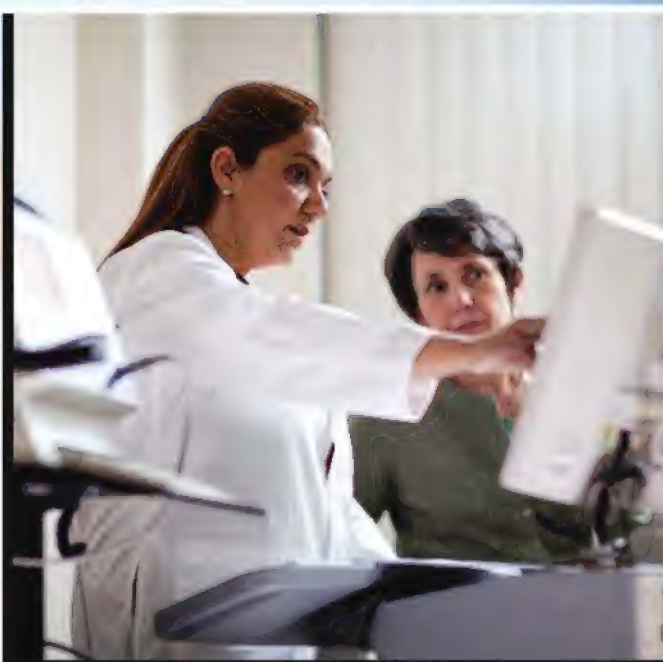
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If you need help paying for your medication **CARES** FOUNDATION *can help,*
and for more information about PRADAXA call 1-877-PRADAXA or visit pradaxa.com.



If you have an irregular heartbeat called *atrial fibrillation*
not caused by a heart valve problem
ask your doctor about **PRADAXA.**

- In a clinical trial, PRADAXA 150 mg **reduced stroke risk 35% more** than warfarin.
Risk reduction was greatest when compared to patients on warfarin
whose blood tests showed lower levels of control.
- **No regular blood tests**

PRADAXA is a prescription blood-thinning medicine used to reduce the risk of stroke and blood clots in people with atrial fibrillation not caused by a heart valve problem. With atrial fibrillation, part of the heart does not beat the way it should. This can cause blood clots to form, increasing your risk of a stroke. PRADAXA lowers the chance of blood clots forming in your body.

IMPORTANT SAFETY INFORMATION ABOUT PRADAXA

PRADAXA can cause bleeding which can be serious and sometimes lead to death. Don't take PRADAXA if you currently have abnormal bleeding or if you have ever had an allergic reaction to it. **Your risk of bleeding with PRADAXA may be higher if you:** are 75 years old or older, have kidney problems, have stomach or intestine bleeding that is recent or keeps coming back or you have a stomach ulcer, take other medicines that increase your risk of bleeding, like aspirin products, non-steroidal anti-inflammatory drugs (NSAIDs) and blood thinners.

Call your doctor or seek immediate medical care if you have any of the following signs or symptoms of bleeding: any unexpected, severe, or uncontrollable bleeding; or bleeding that lasts a long time, unusual or unexpected bruising,

coughing up or vomiting blood; or vomit that looks like coffee grounds, pink or brown urine; red or black stools (looks like tar), unexpected pain, swelling, or joint pain, headaches and feeling dizzy or weak.

It is important to tell your doctor about all medicines, vitamins and supplements you take. Some of your other medicines may affect the way PRADAXA works.

Take PRADAXA exactly as prescribed by your doctor. Don't stop taking PRADAXA without talking to your doctor as your risk of stroke may increase.

Tell your doctor if you are planning to have **any** surgery, or medical or dental procedure, because you may have to stop taking PRADAXA for a short time. PRADAXA can cause indigestion, stomach upset or burning, and stomach pain.

You are encouraged to report negative side effects of prescription drugs to the FDA.

Visit www.fda/medwatch or call 1-800-FDA-1088.

Please see more detailed Medication Guide on next page.

Reduce your risk of a stroke caused by a clot that starts in the heart.

Pradaxa[®]
dabigatran etexilate
CAPSULES



MEDICATION GUIDE
PRADAXA (pra dax' a)
(dabigatran etexilate mesylate)
capsules

Read this Medication Guide before you start taking PRADAXA and each time you get a refill. There may be new information. This Medication Guide does not take the place of talking with your doctor about your medical condition or your treatment.

What is the most important information I should know about PRADAXA?

- PRADAXA can cause bleeding which can be serious, and sometimes lead to death. This is because PRADAXA is a blood thinner medicine that lowers the chance of blood clots forming in your body.
- **You may have a higher risk of bleeding if you take PRADAXA and:**
 - Are over 75 years old
 - Have kidney problems
 - Have stomach or intestine bleeding that is recent or keeps coming back, or you have a stomach ulcer
 - Take other medicines that increase your risk of bleeding, including:
 - aspirin or aspirin containing products
 - long-term (chronic) use of non-steroidal anti-inflammatory drugs (NSAIDs)
 - warfarin sodium (Coumadin®, Jantoven®)
 - a medicine that contains heparin
 - clopidogrel (Plavix®)
 - prasugrel (Effient®)

Tell your doctor if you take any of these medicines. Ask your doctor or pharmacist if you are not sure if your medicine is one listed above.

- PRADAXA can increase your risk of bleeding because it lessens the ability of your blood to clot. While you take PRADAXA:
 - You may bruise more easily
 - It may take longer for any bleeding to stop

Call your doctor or get medical help right away if you have any of these signs or symptoms of bleeding:

- Unexpected bleeding or bleeding that lasts a long time, such as:
 - unusual bleeding from the gums
 - nose bleeds that happen often
 - menstrual bleeding or vaginal bleeding that is heavier than normal
- Bleeding that is severe or you cannot control
- Pink or brown urine
- Red or black stools (looks like tar)
- Bruises that happen without a known cause or get larger
- Cough up blood or blood clots
- Vomit blood or your vomit looks like "coffee grounds"

- Unexpected pain, swelling, or joint pain
- Headaches, feeling dizzy or weak

Take PRADAXA exactly as prescribed. Do not stop taking PRADAXA without first talking to the doctor who prescribes it for you. Stopping PRADAXA may increase your risk of a stroke.

PRADAXA may need to be stopped, if possible, for one or more days before any surgery, or medical or dental procedure. If you need to stop taking PRADAXA for **any reason**, talk to the doctor who prescribed PRADAXA for you to find out when you should stop taking it. Your doctor will tell you when to start taking PRADAXA again after your surgery or procedure.

See "What are the possible side effects of PRADAXA?" for more information about side effects.

What is PRADAXA?

PRADAXA is a prescription medicine used to reduce the risk of stroke and blood clots in people who have a medical condition called atrial fibrillation. With atrial fibrillation, part of the heart does not beat the way it should. This can lead to blood clots forming and increase your risk of a stroke. PRADAXA is a blood thinner medicine that lowers the chance of blood clots forming in your body.

It is not known if PRADAXA is safe and works in children.

Who should not take PRADAXA?

Do not take PRADAXA if you:

- Currently have certain types of abnormal bleeding. Talk to your doctor, before taking PRADAXA if you currently have unusual bleeding.
- Have had a serious allergic reaction to PRADAXA. Ask your doctor if you are not sure.

What should I tell my doctor before taking PRADAXA?

Before you take PRADAXA, tell your doctor if you:

- Have kidney problems
- Have ever had bleeding problems
- Have ever had stomach ulcers
- Have any other medical condition
- Are pregnant or plan to become pregnant. It is not known if PRADAXA will harm your unborn baby.
- Are breastfeeding or plan to breastfeed. It is not known if PRADAXA passes into your breast milk.

Tell all of your doctors and dentists that you are taking PRADAXA. They should talk to the doctor who prescribed PRADAXA for you, before you have **any** surgery, or medical or dental procedure.

Tell your doctor about all the medicines you take, including prescription and non-prescription medicines, vitamins, and herbal supplements. Some of your other medicines may affect the way PRADAXA works. Certain medicines may increase your risk of bleeding. See **“What is the most important information I should know about PRADAXA?”**

Especially tell your doctor if you take:

- rifampin (Rifater, Rifamate, Rimactane, Rifadin)

Know the medicines you take. Keep a list of them and show it to your doctor and pharmacist when you get a new medicine.

How should I take PRADAXA?

- **Take PRADAXA exactly as prescribed by your doctor.**
- Do not take PRADAXA more often than your doctor tells you to.
- You can take PRADAXA with or without food.
- Swallow PRADAXA capsules whole. Do not break, chew, or empty the pellets from the capsule.
- If you miss a dose of PRADAXA, take it as soon as you remember. If your next dose is less than 6 hours away, skip the missed dose. Do not take two doses of PRADAXA at the same time.
- Your doctor will decide how long you should take PRADAXA. **Do not stop taking PRADAXA without first talking with your doctor. Stopping PRADAXA may increase your risk of stroke.**
- Do not run out of PRADAXA. Refill your prescription before you run out. If you plan to have surgery, or a medical or a dental procedure, tell your doctor and dentist that you are taking PRADAXA. You may have to stop taking PRADAXA for a short time. See “What is the most important information I should know about PRADAXA?”
- If you take too much PRADAXA, go to the nearest hospital emergency room or call your doctor or the Poison Control Center right away.

What are the possible side effects of PRADAXA?

PRADAXA can cause serious side effects.

- See “What is the most important information I should know about PRADAXA?”
- Allergic Reactions. In some people, PRADAXA can cause symptoms of an allergic reaction, including hives, rash, and itching. Tell your doctor or get medical help right away if you get any of the following symptoms of a serious allergic reaction with PRADAXA:
 - chest pain or chest tightness
 - swelling of your face or tongue
 - trouble breathing or wheezing
 - feeling dizzy or faint

Common side effects of PRADAXA include:

- indigestion, upset stomach, or burning
- stomach pain

Tell your doctor if you have any side effect that bothers you or that does not go away.

These are not all of the possible side effects of PRADAXA. For more information, ask your doctor or pharmacist.

Call your doctor for medical advice about side effects. You may report side effects to FDA at 1-800-FDA-1088.

How should I store PRADAXA?

- Store PRADAXA at room temperature between 59°F to 86°F (15°C to 30°C). After opening the bottle, use PRADAXA within 30 days. Safely throw away any unused PRADAXA after 30 days.
- Store PRADAXA in the original package to keep it dry. Keep the bottle tightly closed.

Keep PRADAXA and all medicines out of the reach of children.

General information about PRADAXA

Medicines are sometimes prescribed for purposes other than those listed in a Medication Guide. Do not use PRADAXA for a condition for which it was not prescribed. Do not give your PRADAXA to other people, even if they have the same symptoms. It may harm them.

This Medication Guide summarizes the most important information about PRADAXA. If you would like more information, talk with your doctor. You can ask your pharmacist or doctor for information about PRADAXA that is written for health professionals.

For more information, go to www.PRADAXA.com or call 1-800-542-6257 or (TTY) 1-800-459-9906.

What are the ingredients in PRADAXA?

Active ingredient: dabigatran etexilate mesylate

Inactive ingredients: acacia, dimethicone, hypromellose, hydroxypropyl cellulose, talc, and tartaric acid. The capsule shell is composed of carrageenan, FD&C Blue No. 2, FD&C Yellow No. 6, hypromellose, potassium chloride, titanium dioxide, and black edible ink.

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VISIONS

A full-page photograph serves as the background. It depicts a person, likely a miner, standing in the center of a dark, rocky volcanic crater. The person is wearing a headlamp and holding a bright, glowing light source, possibly a torch or a powerful flashlight, which illuminates the surrounding dark, textured rock walls. The overall color palette is dominated by deep reds and oranges from the ambient light, with a striking contrast provided by a bright blue flame visible in the lower right corner of the frame.

Indonesia

The blue flame of burning sulfur flickers near a miner on Kawah Ijen volcano in East Java. The pungent element is mined near the crater's highly acidic lake for such industrial uses as rubber and sugar processing.

PHOTO: OLIVIER GRUNEWALD






United States

In New York Harbor the Statue of Liberty weathers a lightning storm against the sparkle of the New Jersey shore. Although this bolt missed the monument, a few are estimated to strike Lady Liberty each year.

PHOTO: JAY FINE





South Korea

On single breaths of up to a minute and a half, these Korean *haenyeo*, or sea women, search for conch and other edibles off the coast of Jeju Island. With fewer females free diving for a living, the storied tradition is fading.

PHOTO: DAVID HØGSHOLT,
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Crash test dummy? Hardly. An ordinary crash test dummy generates an impressive 119 points of data. A Lexus digital crash test model generates two million—empowering us to diagnose with unprecedented accuracy the impact of a collision on the human body down to individual bones, joints, soft tissues and vital organs. This exponential leap in understanding has not only led to remarkable safety improvements in Lexus vehicles, but has set a new benchmark for the automotive industry. In fact, 20 other automotive companies have already licensed this proprietary technology. When you pursue a higher standard of safety, you don't just engineer an entirely new species of crash test technologies. You engineer amazing. lexus.com/engineeringamazing



the pursuit of

PERFECTION



EDITORS' CHOICE **Suzanne Oberheu Beard** Miami, Florida

Drawn to the surreal sight of a grand piano on a Biscayne Bay sandbar, Beard, 51, captured this image as "the pelicans crowded on it began to lift and fly away." Her shot went viral. How did the piano get there? A local teen, abetted by family and friends, put it there for art's sake.



READERS' CHOICE

Carrie Courtney

Wichita, Kansas

Sitting on her basement floor and using a flash, Courtney, 44, took this shot of her dancing 14-year-old daughter, Emily. "To me this represents a girl learning to fly on her own as a young woman. She is going after a dream, taking a jump and seeing where it takes her."

Your Shot features photographs chosen by our editors and one chosen by our readers via online voting. For more information, go to ngm.com/yourshot.



EDITORS' CHOICE

Arindam Banerjee
Kolkata, India

At Dhuandhar Falls near Jabalpur, Madhya Pradesh, Banerjee captured this photograph of a man who goes after—and brings back—coins tossed by tourists.



We're not the only ones who recommend it all day long.

Aleve is #1 Doctor Recommended* for Arthritis Pain.** Just 2 Aleve have the strength to keep arthritis, back and joint pain away all day. It would take 8 Extra Strength Tylenol† to do that.

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*WKH Data 2010. Survey of orthopedic surgeons.

**Use as directed for minor arthritis pain.

†Comparison to Extra Strength Tylenol based on minimum label dosing for 24 hours.

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In Kent, England, a rescued hen—nearly featherless after life on an industrial farm—wears a hand-knit sweater. It may take months to regrow plumage.

Homes for Hens Does a coddled hen catch your eye? It is a curious sight. But it also represents a serious issue. Year-and-a-half-old hens in British battery farms—known as factory farms in the U.S.—are deemed expendable, despite having several years to live and many eggs to give. These images show how folks are opening their hearts and homes to these refugee birds.

I've always gravitated toward offbeat subjects and people. So when I learned about rescue hens, I could imagine a great visual story about a quirkily important cause. What's more, unlike some animal-rights activists, the battery-hen advocates I've met in London and southern England are refreshingly open-minded, working with the farms to adopt hens and reform the system.

Next year European laws will ban conventional battery cages. Some of England's 11.1 million battery hens will move to bigger digs. Many will need to be "re-homed." I hope the humor and humaneness in these photographs raise awareness of the situation.

THE PHOTOGRAPHER

Ed Thompson

More of the London-based photographer's work can be seen at edwardthompson.co.uk.

What Stauer Clients Are Saying
About Our Hybrid Watches



"Great watch... an
impressive piece straight
out of the box."

— C. FROM COLORADO



No More Mr. Nice Watch

Forget sleek and subtle, the Stauer Colossus Hybrid is one tough timepiece.

Never underestimate your competition. Just ask Demetrius, the unfortunate Greek general who set out to conquer Rhodes in 305 BC. He assumed that a massive force of 40,000 men, a fleet of Aegean pirates and an arsenal of wall-smashing war machines would be enough to crush the tiny Greek island. He was wrong. The Rhodians were tougher than he thought. And so is this watch. If you've always believed that the biggest, baddest watches had to cost big, bad money, the \$79 Stauer *Colossus Hybrid Chronograph* is here to change your mind.

A monument to toughness. The people of Rhodes were ready for Demetrius and repelled his attack. To celebrate, they built the Colossus of Rhodes, a 107-foot bronze and iron giant that towered over the harbor like a ten-story trophy. It warned future invaders that "Rhodes is tougher than you think." You give the same message when you wear the Stauer *Colossus*.

The timepiece that works twice as hard. In designing the *Colossus Hybrid Chronograph*, our instructions to the watchmaker were clear: build it as tough as a battleship and fill it full of surprises. Make it a hybrid, because it should work twice as hard as a regular watch. And make it look like a million bucks, because when you put it on, you should get excited about rolling up your sleeves. Mission accomplished.

A toolbox on your wrist. It will keep you on schedule, but the *Colossus Hybrid* is about much more than time. The imposing case features a rotating gunmetal bezel that frames the silver, black and yellow face. You'll find a battalion of digital displays on the dial arranged behind a pair of luminescent hands and a bold yellow second hand. Powered by a precise quartz movement, the watch is

doubly accurate in analog and digital mode. And it's packed with plenty of handy extras including a bright green EL back-light for enhanced nighttime visibility, a tachymeter along the outer dial and a full complement of alarms and split-second countdown timers. The *Colossus Hybrid* secures with a folded steel bracelet that highlights a row of striking dark center links. It's a rugged watch that's more than ready for your daily grind.

Your Satisfaction is Guaranteed. Wear the Stauer *Colossus Hybrid* for 30 days and if you are not 100% thrilled with your purchase, return it for a full refund of your purchase price. But once you get a taste of more watch for less money, it's likely you'll be back for more... and we'll be waiting.

WATCH SPECS: -Easy-to-read analog/digital modes -Back-lighting and luminescent hands -Tachymeter, countdown timers and alarms -Folded stainless steel bracelet fits a 6 3/4"-8 1/2" wrist

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Keeping chickens isn't just a rural pursuit. On her rooftop in central London, Julia Stephenson—a columnist and former Green Party candidate in U.K. elections—feeds spaghetti to her rescued battery hens.



With her dog at her side and a hen at her heart, Mary Allchurch stands near her country home in Kent. She and her husband first adopted hens in 2006. The three they now have can lay up to 400 eggs a year.



This is "Weasel," an IT specialist for a major insurance company, relaxing with his hens on a Sunday morning in Kent. Sadly, he had to give up his birds when the foxes near his home became a problem.



Sam Bradley, 9—seen with his mother, Sarah, in their Lutton yard—bought his first rescue hen with money saved from his sixth birthday. "I really love chickens," he told me, adding that he wants to be a farmer.



In Kent, Diana Millard has re-homed 7,000 hens since 2004. Her yard is a labyrinth of runs, ramps, and sheds. When I heard her call one bird Lloyd, I really began to see each hen as a distinct personality.

NOW

SKYCAST

*Overhead this month
in parts of the world*



August 13

Peak of the Perseids
meteor shower



August 22

Look for Neptune

Salad Days

Heart disease doesn't just hit humans. It's the leading killer among male zoo gorillas, and scientists want to know why. Obesity? Perhaps, but the term has yet to be defined for the primates. Diet? Likely, and Elena Hoellein Less of Cleveland Metroparks Zoo is trying to prove it. As part of a multi-zoo study, she's been feeding her two gorillas, Bebac and Mokolo (below), a trial menu meant to mimic the largely vegetarian one eaten in the wild. Heavy on leafy greens, the new diet is also modeled after a heart-healthy human one, says Less. Judging by the 65 pounds each of her charges has shed so far, it's nothing to take lightly. —Catherine Zuckerman



Old Menu

Since 2008, 22 gorillas at five zoos—in Cleveland and Columbus, Ohio; Asheboro, North Carolina; Seattle; and Toronto—have been weaned off specially formulated biscuits (above). The edibles delivered all the right nutrients but also a starchy, caloric punch.

New Menu

The gorillas now munch on many pounds a day of slimming, fiber-rich produce—including endive, dandelion greens, romaine lettuce, and alfalfa hay.

PHOTOS (FROM LEFT):
CLEVELAND METROPARKS ZOO;
REBECCA HALE, NGM STAFF

Boys can be affected by HPV disease too.

GARDASIL HELPS PROTECT BOTH YOUR SON AND DAUGHTER.




When it comes to human papillomavirus (HPV), females are only half the equation. There are 30 to 40 types of HPV that will affect an estimated 75% to 80% of males and females in their lifetime. For most, HPV clears on its own. But, for others who don't clear certain types, HPV could cause cervical cancer in females and other types of HPV could cause genital warts in both males and females. And there's no way to predict who will or won't clear the virus.

GARDASIL is the only HPV vaccine that helps protect against 4 types of HPV. In girls and young women ages 9 to 26, GARDASIL helps protect against 2 types of HPV that cause about 75% of cervical cancer cases, and 2 more types that cause 90% of genital warts cases. In boys and young men ages 9 to 26, GARDASIL helps protect against 90% of genital warts cases.

GARDASIL may not fully protect everyone, nor will it protect against diseases caused by other HPV types or against diseases not caused by HPV. GARDASIL does not prevent all types of cervical cancer, so it's important for women to continue routine cervical cancer screenings.

GARDASIL does not treat cervical cancer or genital warts. GARDASIL is given as 3 injections over 6 months.


GARDASIL.
[Human Papillomavirus Quadrivalent
(Types 6, 11, 16, and 18) Vaccine, Recombinant]

gardasil.com

1-800-GARDASIL

IMPORTANT SAFETY INFORMATION

Anyone who is allergic to the ingredients of GARDASIL, including those severely allergic to yeast, should not receive the vaccine. GARDASIL is not for women who are pregnant.

The side effects include pain, swelling, itching, bruising, and redness at the injection site, headache, fever, nausea, dizziness, vomiting, and fainting. Fainting can happen after getting GARDASIL. Sometimes people who faint can fall and hurt themselves. For this reason, your child's health care professional may ask your child to sit or lie down for 15 minutes after he or she gets GARDASIL. Some people who faint might shake or become stiff. This may require evaluation or treatment by your child's health care professional.

Only a doctor or health care professional can decide if GARDASIL is right for your child.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch or call 1-800-FDA-1088. Please read the Patient Information on the next page and discuss it with your child's doctor or health care professional.



Help your **son** or **daughter** be one less person affected by HPV disease.

Talk to your child's doctor about GARDASIL today.

Having trouble paying for your Merck medicine?

Merck may be able to help. Visit merck.com/merckhelps.

HPAP-1000854-0003-05/11

**Patient Information about
GARDASIL® (pronounced "gard-Ah-sill")**

Generic name: [Human Papillomavirus Quadrivalent (Types 6, 11, 16, and 18) Vaccine, Recombinant]

Read this information with care before getting GARDASIL¹. You (the person getting GARDASIL) will need 3 doses of the vaccine. It is important to read this leaflet when you get each dose. This leaflet does not take the place of talking with your health care provider about GARDASIL.

What is GARDASIL?

GARDASIL is a vaccine (injection/shot) that is used for girls and women 9 through 26 years of age to help protect against the following diseases caused by Human Papillomavirus (HPV):

- Cervical cancer
- Vulvar and vaginal cancers
- Anal cancer
- Genital warts
- Precancerous cervical, vaginal, vulvar, and anal lesions

GARDASIL is used for boys and men 9 through 26 years of age to help protect against the following diseases caused by HPV:

- Anal cancer
- Genital warts
- Precancerous anal lesions
- The diseases listed above have many causes, and GARDASIL only protects against diseases caused by certain kinds of HPV (called Type 6, Type 11, Type 16, and Type 18). Most of the time, these 4 types of HPV are responsible for the diseases listed above.
- GARDASIL cannot protect you from a disease that is caused by other types of HPV, other viruses, or bacteria.
- GARDASIL does not treat HPV infection.
- You cannot get HPV or any of the above diseases from GARDASIL.

What important information about GARDASIL should I know?

- You should continue to get routine cervical cancer screening.
- GARDASIL may not fully protect everyone who gets the vaccine.
- GARDASIL will not protect against HPV types that you already have.

Who should not get GARDASIL?

You should not get GARDASIL if you have, or have had:

- an allergic reaction after getting a dose of GARDASIL.
- a severe allergic reaction to yeast, amorphous aluminum hydroxyphosphate sulfate, polysorbate 80.

What should I tell my health care provider before getting GARDASIL?

Tell your health care provider if you:

- are pregnant or planning to get pregnant. GARDASIL is not recommended for use in pregnant women.
- have immune problems, like HIV infection, cancer, or you take medicines that affect your immune system.
- have a fever over 100°F (37.8°C).
- had an allergic reaction to another dose of GARDASIL.
- take any medicines, even those you can buy over the counter.

Your health care provider will help decide if you should get the vaccine.

How is GARDASIL given?

GARDASIL is a shot that is usually given in the arm muscle. You will need 3 shots given on the following schedule:

- Dose 1: at a date you and your health care provider choose.
- Dose 2: 2 months after Dose 1.
- Dose 3: 6 months after Dose 1.

Fainting can happen after getting GARDASIL. Sometimes people who faint can fall and hurt themselves. For this reason, your health care provider may ask you to sit or lie down for 15 minutes after you get GARDASIL. Some people who faint might shake or become stiff. This may require evaluation or treatment by your health care provider.

Make sure that you get all 3 doses on time so that you get the best protection. If you miss a dose, talk to your health care provider.

Can other vaccines and medications be given at the same time as GARDASIL?

GARDASIL can be given at the same time as RECOMBIVAX HB® [hepatitis B vaccine (recombinant)] or Menactra [Meningococcal (Groups A, C, Y and W-135) Polysaccharide Diphtheria Toxoid Conjugate Vaccine] and Adacel [Tetanus Toxoid, Reduced Diphtheria Toxoid and Acellular Pertussis Vaccine Adsorbed (Tdap)].

What are the possible side effects of GARDASIL?

The most common side effects with GARDASIL are:

- pain, swelling, itching, bruising, and redness at the injection site
- headache
- fever
- nausea
- dizziness
- vomiting
- fainting

There was no increase in side effects when GARDASIL was given at the same time as RECOMBIVAX HB [hepatitis B vaccine (recombinant)].

There was more injection-site swelling at the injection site for GARDASIL when GARDASIL was given at the same time as Menactra [Meningococcal (Groups A, C, Y and W-135) Polysaccharide Diphtheria Toxoid Conjugate Vaccine] and Adacel [Tetanus Toxoid, Reduced Diphtheria Toxoid and Acellular Pertussis Vaccine Adsorbed (Tdap)].

Tell your health care provider if you have any of the following problems because these may be signs of an allergic reaction:

- difficulty breathing
- wheezing (bronchospasm)
- hives
- rash

Tell your health care provider if you have:

- swollen glands (neck, armpit, or groin)
- joint pain
- unusual tiredness, weakness, or confusion
- chills
- generally feeling unwell
- leg pain
- shortness of breath
- chest pain
- aching muscles
- muscle weakness
- seizure
- bad stomach ache
- bleeding or bruising more easily than normal
- skin infection

Contact your health care provider right away if you get any symptoms that concern you, even several months after getting the vaccine.

For a more complete list of side effects, ask your health care provider.

What are the ingredients in GARDASIL?

The ingredients are proteins of HPV Types 6, 11, 16, and 18, amorphous aluminum hydroxyphosphate sulfate, yeast protein, sodium chloride, L-histidine, polysorbate 80, sodium borate, and water for injection.

This leaflet is a summary of information about GARDASIL. If you would like more information, please talk to your health care provider or visit www.gardasil.com.

Manufactured and Distributed by: Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc.
Whitehouse Station, NJ 08889, USA

Issued April 2011

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Brazil Expedition Uncovers Thousands of Carats of Exquisite Natural Emeralds

Brandish a whopping 50 carats of genuine South American emeralds in a handcrafted new necklace design for less than \$100.

Halfway into our ambitious trek through the rain forest I had to remind myself that "Nothing good comes easy." These days it seems that every business trip to Brazil includes a sweltering hike through overgrown jungles, around cascading waterfalls and down steep rock cliffs. But our gem broker insisted it was worth the trouble. To tell you the truth, for the dazzling emeralds he delivered, I'd gladly go back to stomping through jaguar country.

Now our good fortune is your great reward. Don't miss this rare opportunity to own an impressive 50 carat strand of genuine South American emeralds for **under \$100**. And for a limited time, we'll sweeten every Carnival Collection order with **\$300 in Stauer Gift Coupons!***

Faced with this embarrassment of riches, our designer transformed this spectacular cache of large stones (each is over 8 carats average weight) into a stunning 50 ctw necklace of faceted emeralds set into .925 sterling silver. Each emerald is surrounded by delicate sterling silver rope work and filigree in the Bali-style. The 18" necklace dangles from a sterling silver chain that fastens with a secure double-sided shepherd's hook clasp.

What is the source of our emerald's timeless appeal?

The enchanting color of the Stauer **Carnaval Faceted Emerald Necklace** comes from nature's chemistry. Our polished and faceted, well-formed natural emeralds are immediately recognized as something special. Indeed, when we evaluated these emeralds, color was the most important quality factor. Today, scientists tell us that the human eye is more sensitive to the color green than to any other. Perhaps that is why green is so soothing to the eye, and why the color green complements every other color in your wardrobe.

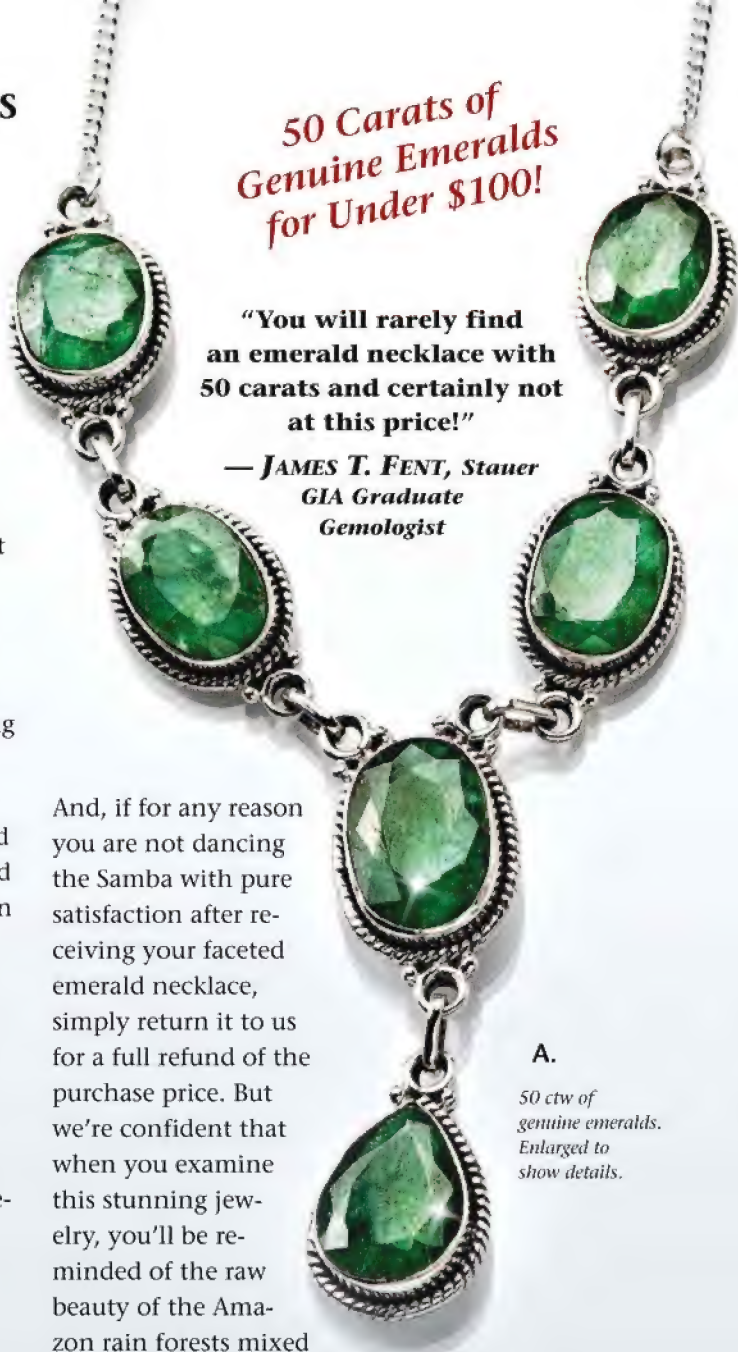
Emeralds are, by weight, the most valuable gemstone in the world.

Now you can wear genuine emeralds and feel great about knowing that you were able to treat yourself to precious gems without paying a precious price. A 100+ carat emerald necklace found on Rodeo Drive or 5th Avenue could cost well over \$250,000...but not from Stauer. Wear and admire the exquisite Stauer **Carnaval Faceted Emerald Necklace** for 30 days.

**50 Carats of
Genuine Emeralds
for Under \$100!**

**"You will rarely find
an emerald necklace with
50 carats and certainly not
at this price!"**

**— JAMES T. FENT, Stauer
GIA Graduate
Gemologist**



A.

50 ctw of
genuine emeralds.
Enlarged to
show details.

And, if for any reason you are not dancing the Samba with pure satisfaction after receiving your faceted emerald necklace, simply return it to us for a full refund of the purchase price. But we're confident that when you examine this stunning jewelry, you'll be reminded of the raw beauty of the Amazon rain forests mixed with the flash and dazzle

of the exotic Carnival in Rio de Janeiro. **Call Today.**
This cache of genuine emeralds is extremely limited.

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- C. **Carnaval Earrings** (20 ctw) **\$129** +S&P
- D. **Carnaval Bracelet** (50 ctw) **\$189** +S&P
- Carnaval Collection** (83 ctw) ~~\$337~~

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to use every month for 12 months, with
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B.



C.



D.

Smart Luxuries—Surprising Prices

An inside look at the moon's molten core

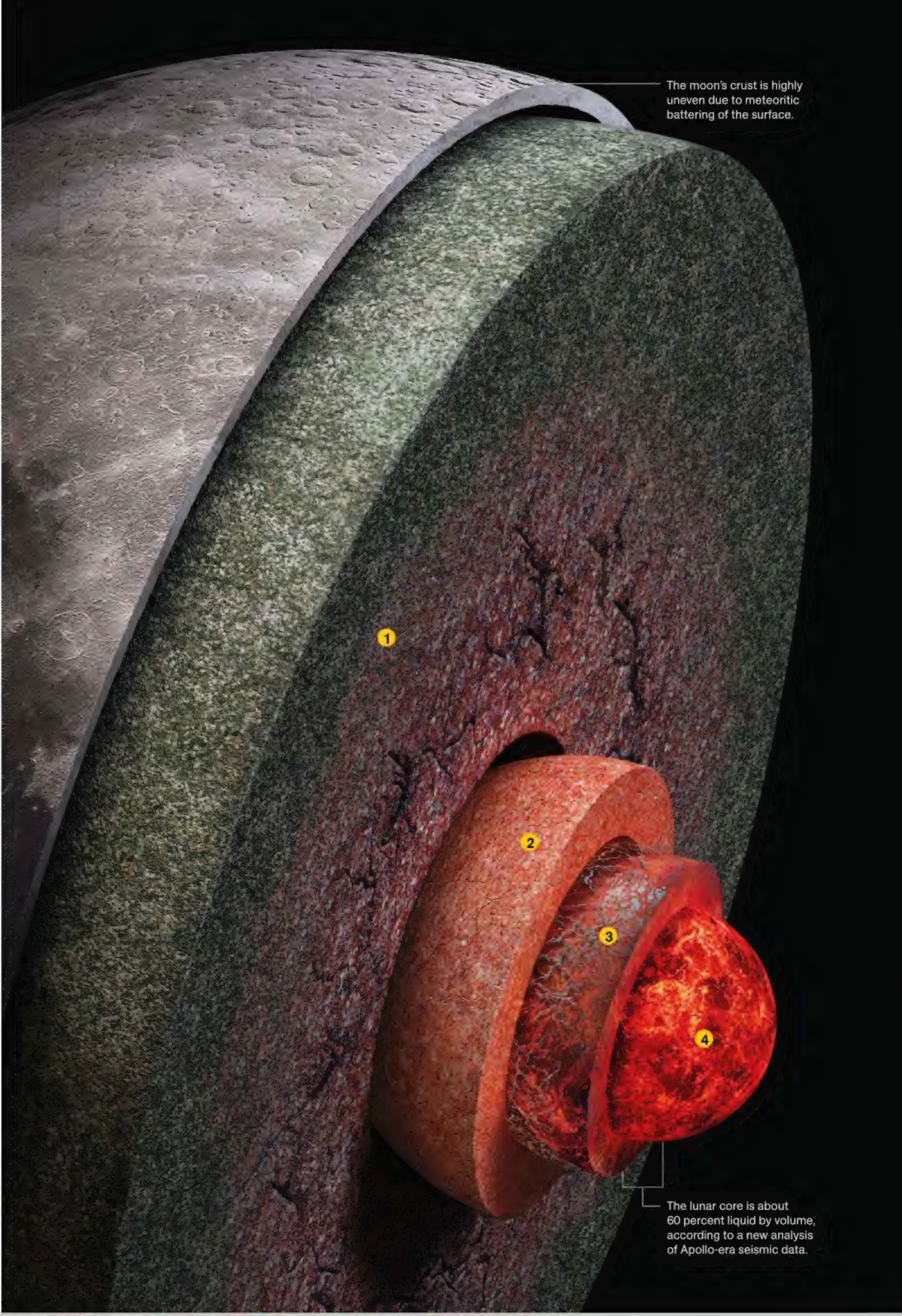
THE FIRE WITHIN | When Apollo astronauts visited the moon, they drilled no deeper than ten feet. Yet the instruments they left behind are helping us learn even today about the inner life of our celestial neighbor. The latest look at seismic data from four decades ago confirms that deep inside this cold, dry satellite is a hot, liquid core.

"The molten core tells us a lot about the evolution of the moon," says NASA's Renee Weber, who studied readings dating from 1969 to 1977, only a quarter of which had been analyzed since the Apollo missions. The power of modern computers enabled Weber and her colleagues to examine the remainder, with a focus on deep moonquakes. Like the Earth, the moon has a center consisting of liquid and solid layers, the innermost being the hottest yet solid due to intense pressure. But whereas the Earth's core is convecting—that is, dynamic, giving rise to plate tectonics, volcanic activity, and a magnetic field—the moon's is thought to be stagnant.

The liquid present in the outer core suggests the moon may have been entirely molten when it formed 4.5 billion years ago, says Weber. "Even though the Earth and moon formed at similar times, the moon is smaller, so it has lost heat and energy faster." At some point the lunar core may have convected as well. How do we know? Magnetic traces on surface samples brought back by the astronauts. —Luna Shyr

THE INTERIOR*	1	2	3	4
Name	Mantle	Partial melt zone	Outer core (liquid)	Inner core (solid)
Depth from surface	25 miles	780 miles	875 miles	930 miles
Contents	Includes olivine, peridotite, and garnet	Peridotite, titanium-rich silicate melt	Liquid iron alloy	Solid iron alloy
Temperature	1,600 kelvins (2,420°F)	1,650 kelvins (2,510°F)	1,700 kelvins (2,600°F)	1,710 kelvins (2,618°F)

*ESTIMATED FIGURES FOR DEPTH AND TEMPERATURE
SEAN MCNAUGHTON. ART: HERNÁN CAÑELLAS. SOURCE: RENEE C. WEBER, NASA



The moon's crust is highly uneven due to meteoritic battering of the surface.

The lunar core is about 60 percent liquid by volume, according to a new analysis of Apollo-era seismic data.

advertisement



Photograph by Annie Griffiths; inset photo of Annie Griffiths photographed by Linda Makarov.

Close view of coyote, Yellowstone National Park, Wyoming



ANNIE GRIFFITHS

NATIONAL GEOGRAPHIC PHOTOGRAPHER, ON

America's National Parks

"My mother and father met at Glacier National Park in 1949—my father took this picture [inset] on their first date. Mom was a summer waitress at the wonderful Many Glacier Hotel. Dad was spending that summer working on a dam nearby. Dad took one look at her and he was sold. From childhood, I imagined the country's parks as places of beauty and romance.

Little did I know that I would one day become a photographer for National Geographic and travel to so many of these sacred places. It still amazes me when I am in a national park and am able to witness animals in



inset photo by Robert H. Griffiths

the wild. The coyote in this photograph [above] was on the hunt in Yellowstone National Park and was so focused on the sounds of prey he could hear under the fresh snow, that he tolerated me getting fairly close. I am so grateful that our country had the foresight to save this land—can you imagine if it were full of condos rather than coyotes? *"*

Nature Valley wants to ensure that our national parks will be preserved for generations to come. Learn more at PreserveTheParks.com.

See more of Annie Griffiths' photographs—and
**ENTER THE NATURE VALLEY® NATIONAL
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Moments like these are worth saving.



preserve
the
parks



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Nature Valley wants to ensure our National Parks will be preserved for generations. That's why we're donating \$400,000 to the National Parks Conservation Association. And with your help, we'll give even more. Simply enter the UPC on specially marked boxes at NatureValley.com and we'll donate an additional 10¢, up to \$100,000, until October 31, 2011.

British
imperial pint
19.2

2/3 pint
12.8 ounces

1/2 pint
9.6

1/3 pint
6.4



Pint Size(s) One-third empty or two-thirds full?

The British Beer & Pub Association (BBPA) is optimistic that another serving-size option for draft pints will revive an industry whose market share is wobbling under the influence of wine and spirits.

British law has long dictated that pubs sell beer and cider only in an imperial pint (above), which is about 20 percent larger than a U.S. pint, or in glasses one-third or one-half that size. But this year Parliament is set to scrap several restrictions on weights and measures to encourage innovation. This would legalize a two-thirds pint—an amount some are calling a schooner based on a similar-size Australian pour.

Brits drink some 23 million pints of beer a day, but sales have dropped 19 percent over the past six years, and 25 pubs close in an average week, says the BBPA's Neil Williams. He thinks the traditional pint glass "is seen as very much a male preserve." If the new size can win over women, the industry may find that less is more. —Amanda Fiegl

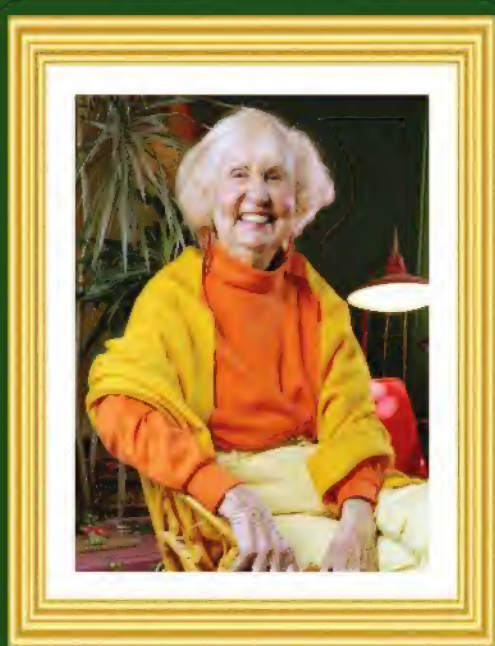
Bugging Out

The Salt Creek tiger beetle (below) is unlovely and obscure. It scuttles, six legged, through its two-year life span in a wetland near Lincoln, Nebraska. Not even its looming demise is novel. By last year all but about 200 adults had disappeared from Little Salt Creek—more victims of urban sprawl and habitat loss, though natural flooding dilutes the salt seeps that feed the marsh.

University of Nebraska entomologist Steve Spomer isn't giving up on the lowly insect. He and a few others have rallied the city and state governments, area zoos, and the U.S. Fish and Wildlife Service to save it. The state has used lottery money to help preserve its habitat. And the bug is being bred in local labs. Why? Because no one knows its real value to the ecosystem. As Spomer says, "If the Salt Creek tiger beetle goes, what goes with it?" —Peter Gwin



Give An *Inspiring* Gift



Pat Minnick included
National Geographic in her
financial plans.

In 2007 Pat Minnick, a professional artist, decided to establish a charitable gift annuity to support National Geographic.

"I feel good knowing that National Geographic is doing so much to protect endangered wildlife," says Pat. "The environmental problems we face are vast, but by joining with National Geographic and their history of remarkable accomplishments, I know we can pass on a more beautiful world."

Pat now receives a guaranteed life income and is a direct part of the Society's efforts to inspire people to care about the planet.

For more information about a charitable gift annuity or other ways to include National Geographic in your estate plans, please see below.

SAMPLE ANNUITY RATES FOR ONE BENEFICIARY

(Rates at other ages available upon request.)

Age 65=5.3% Age 75=6.5% Age 85=8.4%

Rates are subject to change.

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Washington, D.C. 20036-4688





A seahorse's shape—curvy body and arched neck—helps it snare prey.



Spotting the Leopard Writer Rudyard Kipling imagined a leopard's spots came from the fingertips of a human, to help it blend in with the jungle. William Allen of the University of Bristol took a digital approach to breaking the camouflage code of it and other Felidae members. After comparing photos of the cats with a mathematical model of pattern development on their flanks, Allen and colleagues concluded that the complexity of many coat patterns was related to habitat. Spotted cats are typical of closed environments like forests; plain-coated ones tend to inhabit open spaces. Behavior also plays a role. The more time a cat spends in trees and is active at night, for instance, the more elaborately marked its coat is likely to be. "In evolutionary time periods cats can change their patterning relatively easily," says Allen. "Perhaps in the future we may marvel at striped leopards and spotted tigers." —Erin Friar McDermott

The coat patterns of leopards (above) and other cat species evolved to provide camouflage in their habitats.

ET CETERA

A census of **WILD TIGERS** in India shows their numbers have risen 20 percent—from 1,411 to 1,706—since the last count, in 2007. ▀ Two species of **ANTARCTIC PENGUINS** have declined in the past 30 years. Scientists believe krill loss is the cause. ▀ The name **ZHUCHENGTYRANNUS MAGNUS** was bestowed on a *T. rex*-size dinosaur whose fossil was recently discovered in China. ▀ University College London researchers suggest that **POLITICAL BIASES** are reflected in brain structures.

Each Of These Kids Needs Somebody Who Cares Enough To Send \$250. Once.



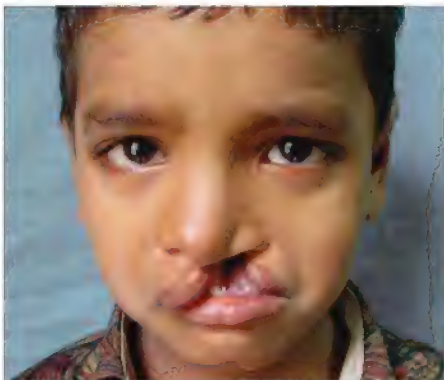
Ming, 6 months, China



Shiva, 1 year, India



Mot, 13 years, Cambodia



Durgap, 5 years, India



Funmi, 8 years, Nigeria



Salazar, 5 years, Philippines

Free cleft surgery which takes as little as 45 minutes and costs as little as \$250, can give desperate children not just a new smile—but a new life.

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dollar for deed—
in the world.”
—The New York Times*

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A Healthy Diet During Pregnancy Can Help Prevent Birth Defects And Clefts. According to the U.S. Government, women should take sufficient levels of folic acid (400 micrograms/day) during pregnancy to help prevent neural tube defects and reduce the risk for cleft lip and palate. When folic acid is taken one month before conception and throughout the first trimester, it has been proven to reduce the risk for neural tube defects by 50 to 70 per cent. Be sure to receive proper prenatal care, quit smoking and drinking alcohol and follow your health care provider's guidelines for foods to avoid during pregnancy. For more information, visit www.smiletrain.org. Smile Train is a 501 (c)(3) nonprofit recognized by the IRS, and all donations to Smile Train are tax-deductible in accordance with IRS regulations. © 2011 Smile Train.

NEXT

A test made from the
blood of horseshoe
crabs just might have
saved your life.





About 500,000 horseshoe crabs are collected annually along the U.S. East Coast under interstate regulations.

In a laboratory, blood is drawn from the crab's primitive equivalent of a heart.

The live crabs are returned to the sea. The estimated mortality rate is 15 percent.

The blood's blue color comes from copper in its oxygen-carrying protein, hemocyanin—akin to the iron-based hemoglobin in humans.



BANKING ON BLUE BLOOD | It's blue, comes from a creature more ancient than dinosaurs, and saves countless human lives. It's the blood of horseshoe crabs, and for decades it's proved vital to biomedical companies that must screen vaccines, IV fluids, and medical devices for bacteria that can be fatal in our bloodstream. Thanks to proteins in cells that act like a primitive immune system, the crabs' blood coagulates instantly when it touches pathogens like *E. coli* and *Salmonella*.

So sensitive is the test derived from the proteins that it can detect amounts as slight as one part per trillion. That's like one grain of sugar in an Olympic-size pool, says John Dubczak of test producer Charles River, Endosafe. Now Princeton University researchers are looking at another approach using synthetic molecules that replicate antimicrobial peptides found on the skin of African clawed frogs. That would take some of the heat off horseshoe crabs—if it can match the sensitivity of their millions-year-old strategy. —Luna Shyr



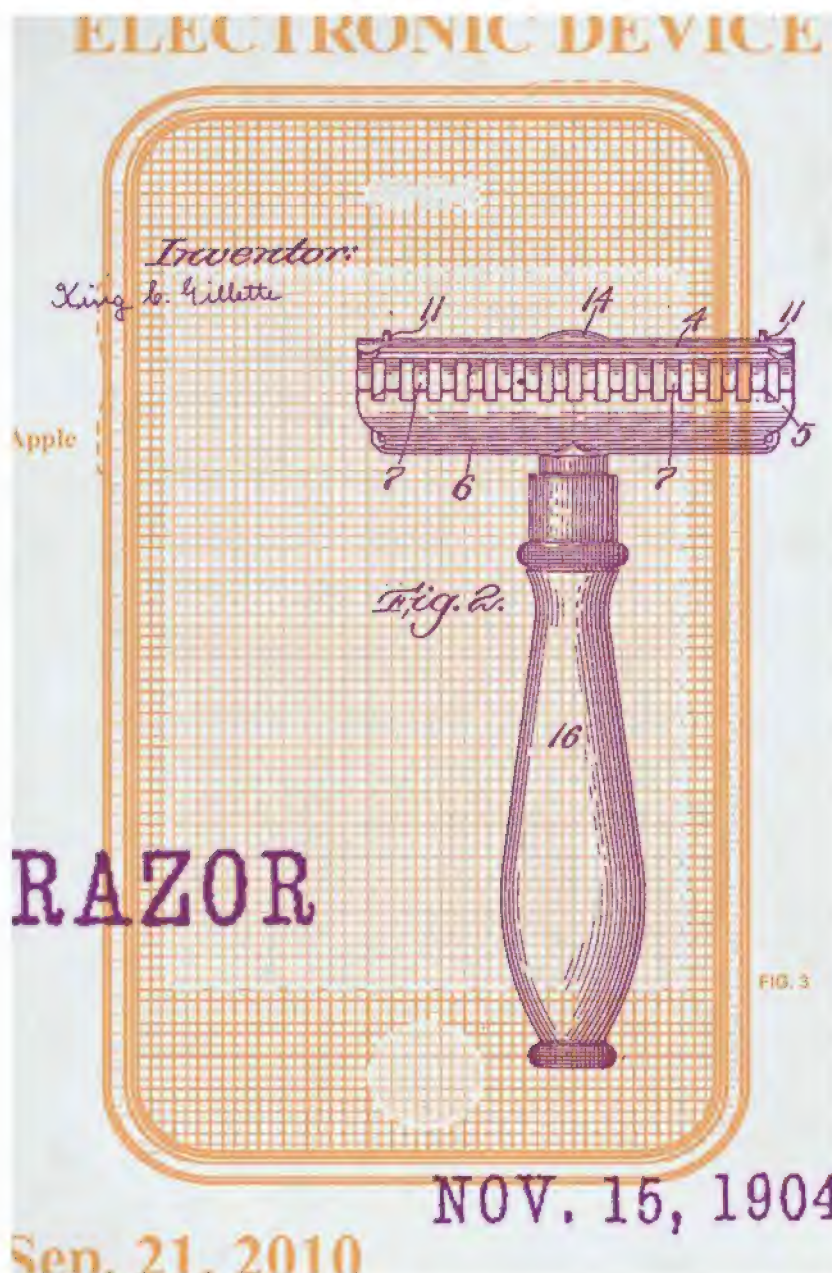
In South Carolina, horseshoe crabs are gathered for their unique bacteria-detecting blood (left). About 20 percent of each crab's blood is collected before it's returned to the water (above).

Patently Problematic

Innovation has gone global. In 2009 American inventors received nearly 53,000 patents abroad, while inventors based in other countries were the recipients of more than half the 167,000 U.S. patents granted. By comparison, in 1900 less than 15 percent of U.S. patents went to nonresidents.

Yet there's no such thing as a universal patent. That's because national standards—including the very definition of what can be patented—vary. And although the trend is toward harmonizing systems by sharing information, according to the U.S. Patent and Trademark Office, a global patent isn't likely anytime soon.

Today's inventors also are stymied by long waits. In the U.S. alone, 1.2 million applications are pending. Congress is now working to streamline the system. Brian Pomper, whose Innovation Alliance represents small companies seeking new patents, hopes it happens soon. "The backlog is a drag on the economy," he says. "All inventions have the potential to create jobs, but if you have to wait three years in legal limbo, pendency is a killer." —Shelley Sperry



Most patents filed in the U.S.—for everything from K. C. Gillette's razor (purple) to an Apple iPhone (orange)—require a drawing of the potential product.



THE STROOP EFFECT Glance at the image to the left and, as quickly as you can, name the animal whose shape is pictured. Chances are you had to stop and think, even if imperceptibly. The reason is the Stroop effect, a type of interference that occurs when the brain has to resolve conflicting meanings. Interpreting what a word means is automatic, so overriding "fish" with "pig," say, likely takes a split second. Named for the psychologist who described the phenomenon, the Stroop doesn't affect everyone—like those who can't read the words in the first place. —Luna Shyr

U.S. GOV'T GOLD AT-COST

TODAY - The U.S. Money Reserve has scheduled the final release of U.S. Gov't Issued \$5 Gold Coins previously held at the U.S. Mint at West Point. These Gov't Issued Gold Coins are being released on a first-come, first-serve basis, for the incredible markup-free price of only \$169.65 each. This "at-cost" Gov't Gold offer will be available for only a limited time, so do not delay. Call a Sr. Gold Specialist today.

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Go to cymbalta.com for a free 30-capsule trial offer.

Cymbalta can help.

Cymbalta is a once-daily, non-narcotic pain reliever. And it's not addictive.

When taken once a day, every day, Cymbalta is proven to significantly reduce chronic low back pain.

You may have to rethink the way you treat your pain. You might be used to taking pain medications only after you feel your chronic low back pain getting worse. Managing this pain with Cymbalta is a little different. It's important to take Cymbalta every day, as prescribed by your doctor, to manage your pain over time.

Visit cymbalta.com or call 1-877-CYMBALTA (1-877-296-2258) to learn more. Ask your doctor about Cymbalta.

Cymbalta is a prescription medication approved for the management of chronic musculoskeletal pain in people with chronic low back pain.

Important Safety Information About Cymbalta **The most important information you should know about Cymbalta:**

Antidepressants can increase suicidal thoughts and behaviors in children, teens, and young adults. Suicide is a known risk of depression and some other psychiatric disorders. Call your doctor right away if you have new or worsening depression symptoms, unusual changes in behavior, or thoughts of suicide. Be especially observant within the first few months of treatment or after a change in dose. Approved only for adults 18 and over.

Cymbalta® (duloxetine HCl) is not for everyone. **Do not take Cymbalta if you:**


- have recently taken a type of antidepressant called a monoamine oxidase inhibitor (MAOI) or Mellaril® (thioridazine)
- have uncontrolled narrow-angle glaucoma (increased eye pressure)

Talk with your healthcare provider:

- about all your medical conditions, including kidney or liver problems, glaucoma, diabetes, seizures, or if you have bipolar disorder. Cymbalta may worsen a type of glaucoma or diabetes
- if you have itching, right upper belly pain, dark urine, yellow skin/eyes, or unexplained flu-like symptoms while taking Cymbalta, which may be signs of liver problems. Severe liver problems, sometimes fatal, have been reported



If you need assistance with prescription costs, help may be available. Visit www.pparx.org or call 1-888-4PPA-NOW.



**Imagine you with less
chronic low back pain.**

Important Safety Information (continued)

- about your alcohol use
- about all your medicines, including those for migraine, to address a potentially life-threatening condition. Symptoms may include high fever, confusion, and stiff muscles
- if you are taking NSAID pain relievers, aspirin, or blood thinners. Use with Cymbalta may increase bleeding risk
- before stopping Cymbalta or changing your dose
- if you experience dizziness or fainting upon standing while taking Cymbalta. This tends to occur in the first week or when increasing the dose, but may occur at any time during treatment
- about your blood pressure. Cymbalta can increase your blood pressure. Your healthcare provider should check your blood pressure prior to and while taking Cymbalta
- if you experience headache, weakness, confusion, problems concentrating, memory problems, or feel unsteady while taking Cymbalta, which may be signs of low sodium levels
- if you develop problems with urine flow while taking Cymbalta
- if you are pregnant or plan to become pregnant during therapy, or are breast-feeding

Most common side effects of Cymbalta (this is not a complete list):

- nausea, dry mouth, sleepiness, fatigue, constipation, dizziness, decreased appetite, and increased sweating

You are encouraged to report negative side effects of Prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.

Other safety information about Cymbalta:

- Cymbalta may cause sleepiness and dizziness. Until you know how Cymbalta affects you, you should not drive a car or operate hazardous machinery.
- People age 65 and older who took Cymbalta reported more falls, some resulting in serious injuries.

How to take Cymbalta:

Take Cymbalta exactly as directed by your healthcare provider. Cymbalta should be taken by mouth. Do not open, break or chew capsule; it must be swallowed whole. Cymbalta can be taken with or without food.

DD CON-A ISI 21APR11

See back page for additional information about Cymbalta, including Boxed Warning about antidepressants and risk of suicide.



Cymbalta[®] DELAYED
duloxetine HCl RELEASE
20 mg, 30 mg, 60 mg CAPSULES

Lilly

Information For Patients About Cymbalta

Please read this information carefully before you, or your family member start taking Cymbalta (sim-BALL-tah), and each time your prescription is refilled, in case anything has changed or new information has become available. This information is not meant to take the place of discussions with your healthcare provider. Talk with your healthcare provider or pharmacist if there is something you do not understand or if you want to learn more about Cymbalta. Always follow your healthcare provider's instructions for taking Cymbalta.

What is the most important information I should know about Cymbalta?

Warning: In clinical studies, antidepressants increased the risk of suicidal thinking and behavior in children, adolescents, and young adults with depression and other psychiatric disorders. Anyone considering the use of Cymbalta or any other antidepressant must balance this risk with the clinical need. Short-term studies did not show an increase in the risk of suicidal thinking or behavior with antidepressants in adults older than 24; there was a reduction in risk with antidepressants in adults 65 and older. Suicide is a known risk of depression and some other psychiatric disorders. All patients starting antidepressant therapy should be monitored appropriately and observed closely. Families and caregivers should discuss with the healthcare provider right away any observations of worsening depression symptoms, suicidal thinking and behavior, or unusual changes in behavior. Cymbalta is not approved for use in patients under age 18.

Patients on antidepressants and their families or caregivers should watch for new or worsening depression symptoms, unusual changes in behavior, and thoughts of suicide, as well as for anxiety, agitation, panic attacks, difficulty sleeping, irritability, hostility, aggressiveness, impulsivity, restlessness, or extreme hyperactivity. Call your healthcare provider right away if you have thoughts of suicide or if any of these symptoms is severe or occurs suddenly. Be especially observant within the first few months of treatment or whenever there is a change in dose.

What is Cymbalta?

Cymbalta is a prescription medicine that is approved to treat multiple conditions. Cymbalta is approved for the treatment of major depressive disorder (MDD), also called depression; generalized anxiety disorder (GAD); the management of fibromyalgia (FM); the management of diabetic peripheral neuropathic pain, also called diabetic nerve pain (DNP); and the management of chronic musculoskeletal pain due to chronic osteoarthritis pain and chronic low back pain.

Who should NOT take Cymbalta?

You should not take Cymbalta if:

- You are taking a type of antidepressant known as a monoamine oxidase inhibitor (MAOI), such as Nardil® (phenelzine sulfate), Parnate® (tranylcypromine sulfate), or Emsam® (selegiline transdermal system). Using an MAOI with many prescription medicines, including Cymbalta, can cause serious or even life-threatening reactions. You must wait at least 14 days after you

have stopped taking an MAOI before you take Cymbalta. You need to wait at least 5 days after you stop taking Cymbalta before you take an MAOI

- You have uncontrolled narrow-angle glaucoma (increased eye pressure)
- You are taking an antipsychotic medicine known as Mellaril® (thioridazine)

What should I talk to my healthcare provider about?

Talk with your healthcare provider:

- About any medical conditions you may have, including kidney or liver problems, glaucoma, diabetes, seizures, or if you have bipolar disorder. Cymbalta may worsen a type of glaucoma or the control of blood sugar in some patients with diabetes
- If you have itching, right upper belly pain, dark urine, yellow skin/eyes, or unexplained flu-like symptoms while taking Cymbalta, which may be signs of liver problems. Severe liver problems, sometimes fatal, have been reported
- About your alcohol use
- If you are taking or plan to take any prescription or nonprescription medicines, as Cymbalta may interact with some of these products
- If you take medications known as triptans, commonly prescribed for migraines. A potentially life-threatening condition may occur when triptans are used with Cymbalta. Symptoms may include high fever, confusion, and stiff muscles
- If you take NSAID pain relievers, aspirin, or blood thinners, as these medications may increase risk of bleeding when used with Cymbalta
- Before stopping Cymbalta or changing your dose. Stopping Cymbalta may result in symptoms including dizziness, nausea, or headache (not a complete list). Your healthcare provider may wish to decrease the dose slowly
- If you are pregnant, plan to become pregnant, or are breastfeeding
- If you experience dizziness or fainting upon standing while taking Cymbalta. This tends to occur in the first week or when increasing the dose, but may occur at any time during treatment, or when used in combination with certain other drugs
- About your blood pressure. Cymbalta can increase your blood pressure. Your healthcare provider should check your blood pressure prior to and while taking Cymbalta
- If you experience headache, weakness, confusion, problems concentrating, memory problems, or feel unsteady while taking Cymbalta, which may be signs of low sodium levels
- If you develop problems with urine flow while taking Cymbalta

What should I avoid while taking Cymbalta?

- Cymbalta may cause sleepiness and dizziness. Until you know how Cymbalta affects you, you should not drive a car or operate hazardous machinery

What are the most common side effects of Cymbalta?

- In clinical studies for approved indications (depression, generalized anxiety disorder, diabetic nerve pain, fibromyalgia, and chronic musculoskeletal

pain including chronic pain due to osteoarthritis and chronic low back pain), the most common side effect was nausea

- Other common side effects included dry mouth, sleepiness, fatigue, constipation, dizziness, decreased appetite, and increased sweating

This is not a complete list of side effects.

See Boxed Warning, "Who should NOT take Cymbalta?" and "What should I talk to my healthcare provider about?" See full prescribing information at www.cymbalta.com. Talk to your healthcare provider if you have questions or develop any side effects.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.

What else should I know if I'm 65 or older?

- People age 65 and older who took Cymbalta reported more falls, some resulting in serious injuries

What should I do if I think I have taken an overdose of Cymbalta?

If you have taken more Cymbalta than has been prescribed for you, contact your healthcare provider, a hospital emergency department, or the nearest poison control center immediately.

How should I take Cymbalta?

- Take Cymbalta exactly as directed by your healthcare provider
- Cymbalta should be taken by mouth. Do not open, break, or chew the capsule; it must be swallowed whole
- Cymbalta can be taken with or without food
- If you miss a dose, take it as soon as you remember. However, if it is time for your next dose, skip the missed dose and take only your regularly scheduled dose. Do not take more than the daily amount of Cymbalta that has been prescribed for you
- Remember to refill your prescription before you run out of Cymbalta
- Talk with your healthcare provider before stopping Cymbalta or changing your dose

General advice about Cymbalta

- Store Cymbalta at room temperature and out of the reach of children
- Medicines are sometimes prescribed for purposes other than the ones listed. This medication has been prescribed for your particular condition. Do not use it for another condition or give this drug to anyone else
- If you have any questions or concerns, want to report any problems with the use of Cymbalta, or want more information, contact your healthcare provider or pharmacist

Additional information can be found at www.cymbalta.com.

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A Thousand Words a Frame

Love, music, and math have all been called “the international language.” But nowhere is a lingua franca more vital than in places of conflict, where a failure to communicate can be fatal.

With that in mind, the U.S. military has issued pamphlets like this one (right) to Army units serving in Afghanistan. Produced by a Virginia firm with input from linguists, graphic designers, military consultants, and technology engineers, these booklets can help troops and locals get their point across in terms that are purely visual.

John Clark, an Army helicopter pilot stationed in Afghanistan, says nonverbal dialogue is key in a country with multiple languages and dialects. “In the event of a crash,” he adds, a simple picture could be “an invaluable tool to the survivor trying to make it back to friendly lines.” —Jeremy Berlin



Where Is the Bomb?

A complex concept or question can be shown in a few frames. By pointing to these pictures, an American soldier with no knowledge of Pashto can tell an Afghan man that information about a bombmaker will translate into a monetary reward.

BRAINSTORMS

Wales plans to produce **GENETIC BAR CODES** for all of its 1,143 species of native flowering plants. ▪ Scientists have observed **FOG ON MARS** courtesy of NASA's Phoenix lander, bolstering evidence of a water cycle similar to our planet's. ▪ Five new genes linked to **ALZHEIMER'S** have been identified, providing new clues about the roots of the disease. ▪ A global monitoring network reveals that **THUNDERSTORMS** strike the Earth approximately 760 times every hour.

A lush, moss-covered forest floor with tall, slender trees in the background. The ground is covered in a thick layer of green moss and ferns. The trees are tall and thin, with some moss growing on their trunks. The lighting is soft and dappled, creating a serene atmosphere.

SPIRIT

BEAR

In a moss-draped rain forest in British Columbia, towering red cedars live a thousand years, and black bears are born with white fur.

PHOTOGRAPHS BY PAUL NICKLEN






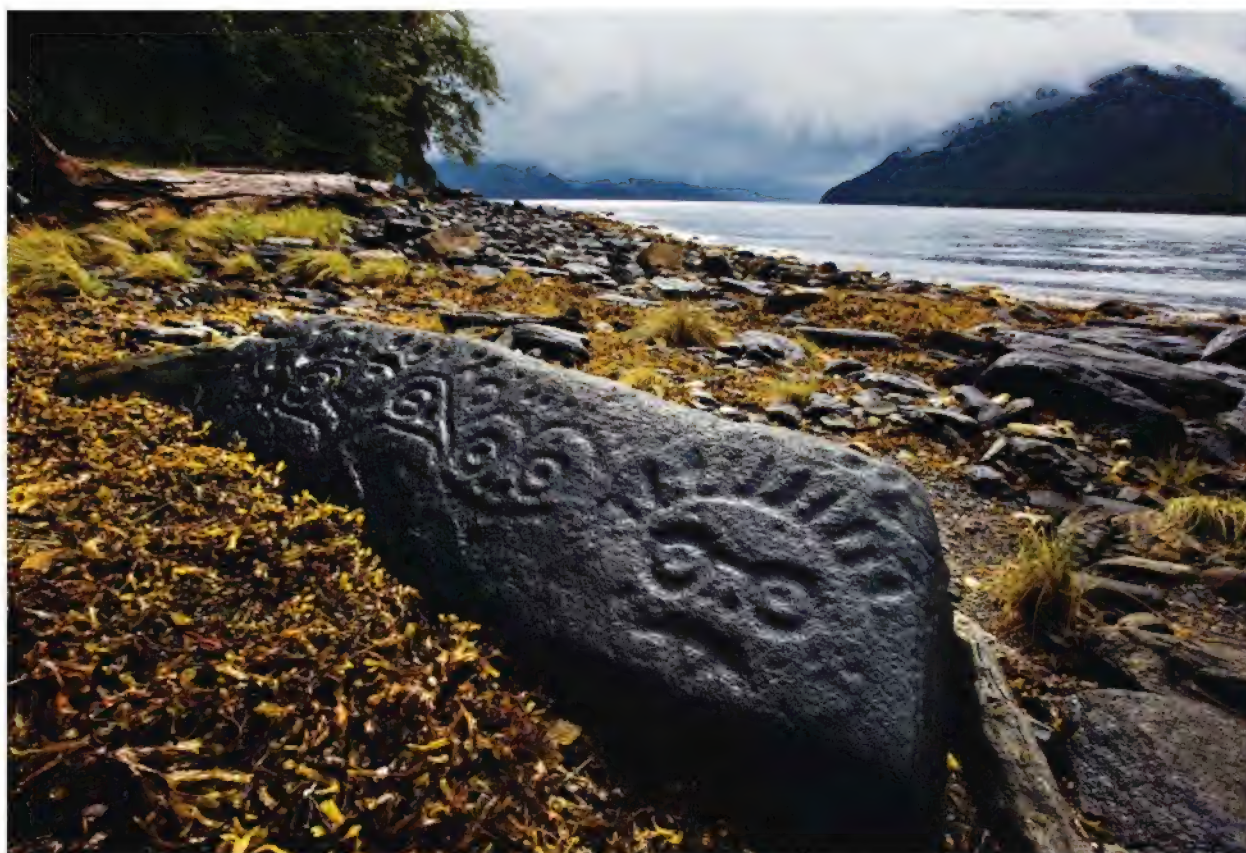


A white-coated black bear gorges on salmon roe to pack on fat for the winter. Triggered by a recessive trait, the bear's white coat may make it less threatening than a black coat to spawning fish, giving the bears an advantage when fishing during daytime.



A long-exposure photograph of a waterfall cascading over dark, mossy rocks. The water is blurred into white streaks, creating a sense of motion. The rocks are dark and textured, with patches of moss and lichen. The overall scene is dramatic and naturalistic.

With a population of 400 to as many as a thousand, the spirit bear may owe its survival to the protective traditions of the First Nations, who never hunted the animals or spoke of them to fur trappers.



BY BRUCE BARCOTT

On a drizzly autumn morning on the coast of British Columbia,

a shadowy figure lumbers down to shore. A black bear has come to eat. It's spawning season. Egg-heavy fish glut the streams of Gribbell Island, a small piece of Canada's Great Bear Rainforest, one of the largest coastal temperate rain forests in the world. The bear pauses on a patch of rockweed algae to sniff the air. The rain and mist can't mask the funky rot. Pink and chum salmon carcasses lie tangled in linguine strands of tidal sedge. The bear moves like a silhouette across the landscape, its black fur blending in with the dark rocks and dusky woods.

Marven Robinson spots the bear but turns away, uninterested. "We might have better luck upstream," he says. Robinson, 43, stocky and swathed in rain gear, is a wildlife guide and member of the Gitga'at First Nation, whose traditional territory includes Gribbell Island. This bear isn't what he's looking for. He's after a more revered and rare creature: what the Gitga'at call *mooksgmòl*, the spirit bear, a walking contradiction—a white black bear.

Neither albino nor polar bear, the spirit bear (also known as the Kermode bear) is a white variant of the North American black bear, and it's found almost exclusively here in the Great Bear Rainforest. At 25,000 square miles—one and a half times as big as Switzerland—the region runs 250 miles down Canada's western coast and encompasses a vast network of mist-shrouded fjords, densely forested islands, and glacier-capped mountains. Grizzlies, black bears, wolves, wolverines, humpback whales, and orcas thrive along a coast that has been home to First Nations like the Gitga'at for hundreds of generations. It's a spooky, wild, mysterious place: There are wolves here that fish. Deer that swim. Western red cedar trees that have stood a thousand years or more. And a black bear that is white.

As his boots slosh up a soggy trail fringed with ferns and devil's club, Robinson scans for movement. No bears. He spots a tuft of white fur snagged on an alder branch. "They're around here, for sure," he says. He points to the chewed



Ranging across British Columbia's north coast, Kermode bears cluster on Princess Royal Island and Gribbell Island, where a petroglyph (left) reflects many centuries of human presence.

bark. "They like to stand and bite the tree just to say to other bears, I'm here using this river."

An hour passes. Robinson waits patiently on top of a moss-patched boulder. Then he sees a rustling in the bush. "There he is," he says.

A white bear steps out of the tree cover onto a streamside rock. Set against the dark palette of the rain forest, the bear's fur appears shabbily radiant. Not pure white, exactly. More like a vanilla-colored carpet in need of a steam cleaning. The bear swings its head from side to side, peering into an eddy for salmon. Before it can lunge for one, a black bear suddenly comes out of the forest and runs the white bear off its perch—though "runs" might be a bit strong. Everything the bears do seems to unfold in slow motion, as if they're trying to conserve every last calorie for the coming winter. The white bear lumbers into a thicket and disappears.

Robinson watches. He's spent 15 years among the spirit bears. Still, he's transfixed. "This particular white bear is very submissive," he says. "Sometimes that gets to me. I'm protective.

I once saw an old white bear attacked by a younger black bear. I was about to jump in and pepper spray the black one. The instinct was strong in me. But then the white one reared up and threw him off." Robinson smiles, as if to admit the absurdity of a man jumping into a bear fight. But in his eyes there's a hint that he might have done it.

ROBINSON ISN'T ALONE. That same protective instinct runs strong throughout the Great Bear Rainforest. It's one of the factors that have kept the spirit bear alive.

"Our people never hunted the white bear," says Helen Clifton, sitting in her kitchen in Hartley Bay, a small fishing village marked by tendrils of wood smoke and the echoing calls of ravens. Strong in voice and spirit, the 86-year-old Clifton is a clan matriarch of the Gitga'at, one of 14 bands that make up the Tsimshian people of British Columbia's northwest coast. Bear meat was rarely a main food, she says. But First Nations hunters went after black bear in greater numbers when European merchants established the British Columbian fur trade in the late 18th century. Even in those days, though, taking a white bear was taboo, a tradition that has continued through many generations. "We never even spoke of the spirit bear at the dinner table," Clifton says.


That tight-lipped custom might have been an early form of environmental protection. By not speaking of the bear, much less hunting it, the Gitga'at and neighboring bands never let word of the creature reach the ears of fur traders. Even today the Gitga'at and Kitasoo/Xai'xais people keep a watchful eye on their bears during hunting season. "It's not a good idea to come after black bear in our territory," says Robinson. "You never know. Our bears might shoot back."

That attitude makes a difference. For decades the presence of poachers and trophy hunters—as well as mills and a cannery—made grizzlies in the Great Bear scarce and skittish. The industries are now gone, as is the grizzly hunt in parts of the rain forest. The bears are responding. "In my early years it was really something to see a grizzly bear," Doug Stewart tells me. As a fisheries

A close-up photograph of a young male grizzly bear in a forest. The bear's thick, light-colored fur is visible on the right side of the frame. The background is a dense forest with green foliage and moss-covered logs. The lighting is soft, filtering through the trees.

Although spirit bears are extremely reclusive, this young male boldly made repeated trips out of cover into the open to fish. The bears share the forest with wolves, bald eagles, and—warily—grizzly bears.





*A mother of two cubs climbs
a Pacific crab apple tree to
grab its tart and tiny fruit.
In years when autumn
salmon numbers are low,
the bears must find other
food, such as wild berries,
lupine roots, and mussels.*



patrolman, Stewart has been monitoring fish runs in the Great Bear for over 35 years. “Now you see them all the time. I may come across five grizzlies in a morning.”

They’re doing so well, in fact, that some wonder if the grizzly’s return isn’t pushing black bears, and some white ones, off the best fishing stations on the rivers. “Where you see a griz, you won’t see a black bear—or a white one,” says Doug Neasloss, a Kitasoo/Xai’xais wildlife guide. “The black bears give griz plenty of room.”

That leads to an intriguing possibility: Perhaps the griz had a hand in concentrating the Kermode gene on Princess Royal and Gribbell Islands. “Grizzlies and black bears coexist everywhere except these smaller islands,” says Thomas Reimchen, a biologist at the University of Victoria. “There’s not enough habitat for grizzlies on those smaller islands. They need big grassy estuaries, subalpine habitat, and an enormous home range, which those islands don’t offer.”

The islands do offer something else: the eyes of humans watching over them. “I tell the younger people,” says Helen Clifton, “when you see a spirit bear, don’t get on the VHF and broadcast it. If you want to tell someone, say you saw mooksgm’ol. They’ll know what you mean. And it’ll keep the bears safe.”

SCIENTISTS KNOW how black bears are born white. They’re just not sure why. The phenomenon, known as Kermodism, is triggered by a recessive mutation at the *MC1R* gene, the same gene associated with red hair and fair skin in humans. To be born white, a bear must inherit the mutation from both parents. The parents themselves don’t have to be white. They just need to carry the recessive mutation. So it’s not uncommon for white bears to be born to black parents.

White fur occurs in only one of every 40 to 100 black bears on the British Columbia mainland coast, but the trait is especially pronounced on certain islands in the Great Bear Rainforest.

Bruce Barcott last wrote about impacts of the Gulf oil spill. Paul Nicklen’s photographs of wildlife on South Georgia Island appeared in December 2009.

HOW BLACK PLUS BLACK CAN BEGET WHITE

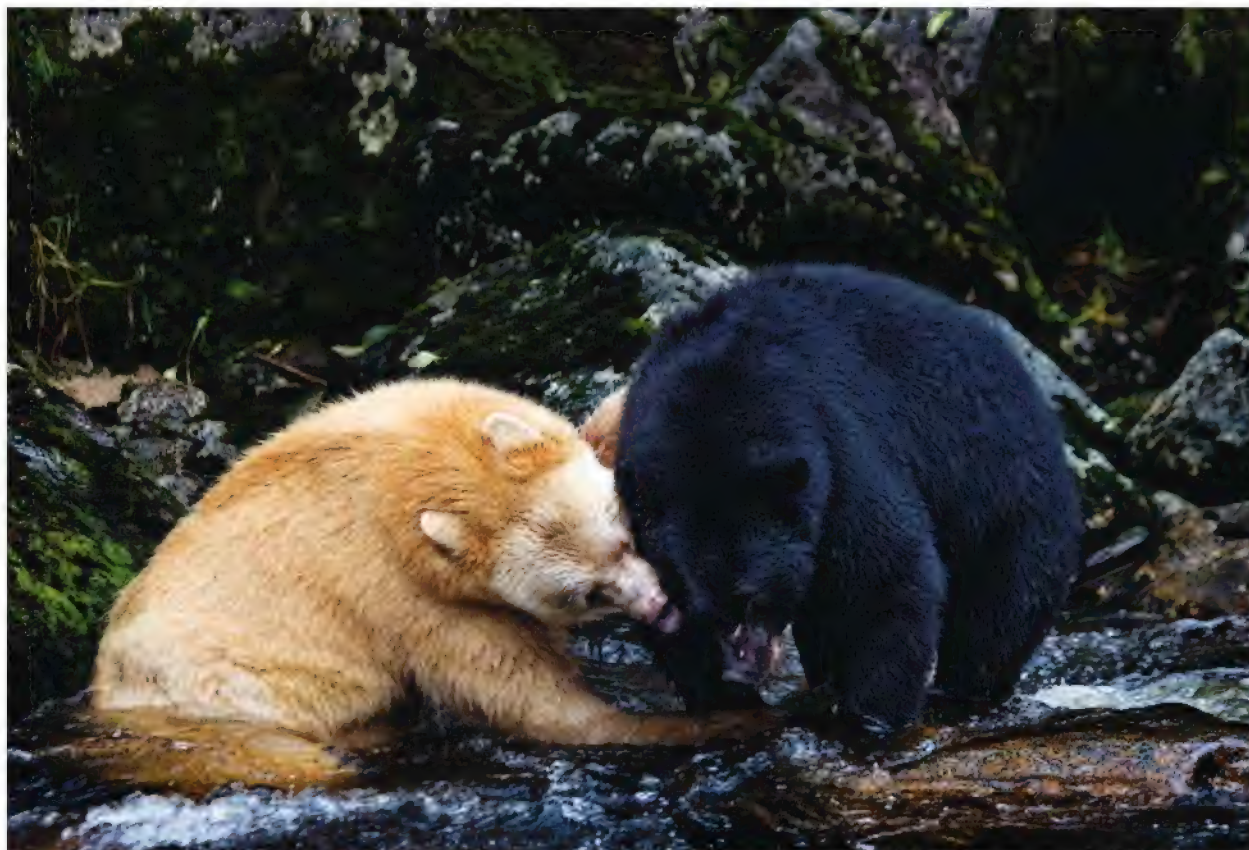


Two bears with black coats can produce a white-coated cub if both mother and father have a recessive trait for Kermodism. They would then have a one-in-four chance of siring a spirit bear.

On Princess Royal Island, one in ten black bears is white. On Gribbell Island, directly north of Princess Royal, it’s one in three. Biologist Wayne McCrory of the Valhalla Wilderness Society calls Gribbell “the mother island of the white bears.”

It’s unclear how the trait arose. One theory was the “glacial bear” hypothesis that Kermodism represented a remnant adaptation from the last great ice age, which ended here 11,000 years ago. At that time most of modern-day British Columbia was still icebound, and a white coat may have offered camouflage. But the glacial bear theory raised a question: Why didn’t the white fur trait die out when the glaciers receded?

To learn more, Doug Neasloss and I go looking for bears on Princess Royal Island. “Hey, bear,” Neasloss says, as he hops out of a boat near the mouth of a small river. It’s like he’s hailing a friend named Bear, though there are no animals in sight. “You don’t want to startle them,” says the 28-year-old guide, who works the traditional territory of the Kitasoo/Xai’xais. A can of grizzly-strength pepper spray rests in a holster on his hip.



Two adult males tussle over a prime fishing spot in a river. "Bear scraps are rare events," says Doug Neasloss, a Kitasoo/Xai'xais wildlife guide. "There's a high potential for injury, so they avoid conflict if they can."

Crunching across barnacle-encrusted boulders, Neasloss parts the curtain of the rain forest. Under the canopy everything turns soft and muted. Lichen drips from hemlock, cedar, and yew branches. His rubber boots leave no print on the spongy ground, which is so green it appears as if the sky has let loose a snowfall of moss.

Neasloss claims a spot under a hemlock tree and pulls his hood tight against the ceaseless rain. He saw a white bear near here recently, he says, though there's no guarantee it'll reappear. At a little past three, he points across the river. A white bear waddles down the riverbank. This bear's bigger and more confident than the Gribbell Island bear. Fat rolls down its belly. It appears to be wearing a coat two sizes too large. It perches over a small pool, then lunges with both paws and comes up with a plump three-foot chum salmon.

Researchers have recently proved that the spirit bear's white coat gives it an advantage when fishing. Although white and black bears tend to have the same success rate after dark—when bears do a lot of their fishing—scientists Reimchen and Dan Klinka from the University

of Victoria noticed a difference during the daytime. White bears catch salmon in one-third of their attempts. Black individuals are successful only one-quarter of the time. "The salmon are less concerned about a white object as seen from below the surface," Reimchen speculates. That may answer part of the question about why the white-fur trait continues to flourish today. If salmon are a coastal bear's primary fat and protein source, a successful female can feast on salmon to store more fat for winter, potentially increasing the number of cubs she can produce.

As the rain continues to fall on Princess Royal Island, Neasloss and I watch the spirit bear feed on a bounty of salmon. When the pickings are this good, bears can turn finicky. Some eat only the fish head. Others may slit the belly and suck out the eggs. Some are gluttons. "I once saw a spirit bear eat 80 salmon at one sitting," Neasloss says. This bear prefers to dine privately. It turns with the salmon in its teeth and runs straight uphill to some unseen hideaway. Twenty minutes later the bear returns, nabs another fish, and takes it into the forest. This goes on for hours, until daylight fades from the sky. □



With a pink salmon in its jaws, a five-year-old male retreats into the forest before slitting open the fish's belly and eating only the eggs. Other bears may consume everything, from head to tail.







In a forest dominated by second-growth trees, a young bear settles into a mossy day bed at the foot of a giant, old-growth western red cedar. Bears use such day beds to rest and sleep after a meal.



Safe and secure for now, the spirit bear recently gained additional protection when British Columbia made it an offense of up to \$104,000 (\$100,000 Canadian) to shoot a white bear anywhere in the province.

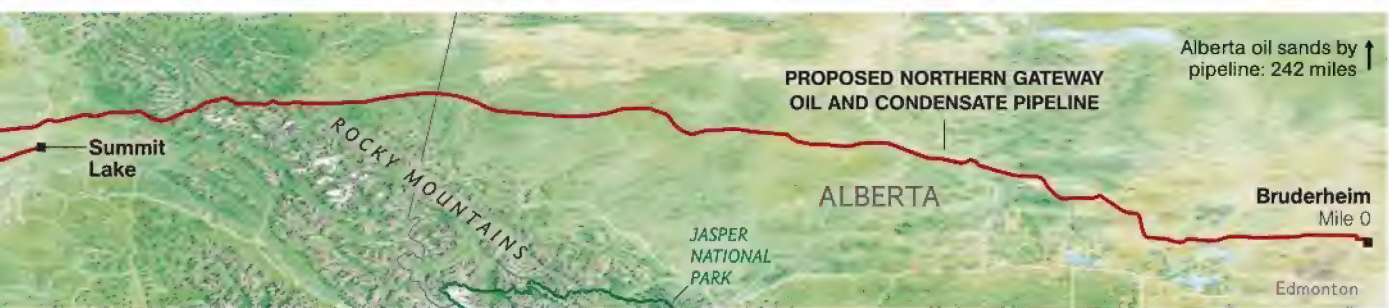




PIPELINE THROUGH

Why oil sands, a sunken ferry, and the price of oil in China have the Great Bear Rainforest in an uproar.

FLORIAN SCHULZ (TOP); THOMAS P. PESCHAK
NGM MAPS; ECKHARD ZEIDLER, Z-POINT GRAPHICS
SOURCES: ENBRIDGE; PLATTS



PARADISE



Purple sea stars and eelgrass (above) flourish in the biologically rich waters off the rocky coasts of places such as Campania Island (top) in British Columbia.





Snowcapped peaks rise from a narrow arm of Cascade Inlet on the British Columbian coast. Just a hundred miles away, a proposed oil tanker route would send vessels through a similar maze of fjords and channels.

PAUL NICKLEN; AERIAL SUPPORT BY LIGHTHAWK

BY BRUCE BARCOTT

The *Queen of the North* was the pride of the BC Ferries fleet—right up

until the night she sank. On March 22, 2006, during a routine run from Prince Rupert to Port Hardy, the ferry exited the narrow 45-mile Grenville Channel just past midnight. Then something went wrong. The officer at the helm, distracted by a conversation with another crew member, neglected to turn after leaving the channel, which points like a rifle barrel at the tip of Gil Island. At 12:20 a.m. the ferry's bow met the island's rock at a speed of 17.5 knots, ripping a hole in the hull. One hour and 20 minutes later, the *Queen* came to rest under 1,400 feet of water.

Of the 101 people aboard, 99 survived, thanks largely to the citizens of nearby Hartley Bay, who put to sea in fishing boats in the middle of the rainy, windy night to rescue them. Two passengers were never found. Today the *Queen of the North* remains where she sank. Every day, a little more fuel leaks out of her tanks, which still hold tens of thousands of gallons of diesel.

"We had to learn a new language," recalled Helen Clifton, a matriarch of the Gitga'at, one of the First Nations bands living along the coast. "'Sheen,' 'shine,' 'bubbling,' 'boom.' It opened our eyes to what happens in a disaster."

Now, when the Gitga'at people of Hartley Bay discuss the proposed Northern Gateway project, an oil pipeline that would turn these same waters into a super-tanker expressway, they always mention the *Queen*. The accident taught them two lessons, they say. No matter how safe the ship, the most mundane human error can sink it. And when disaster strikes, they alone will be left to clean up the mess.

That leaves them skeptical about the pipeline and the tankers it would

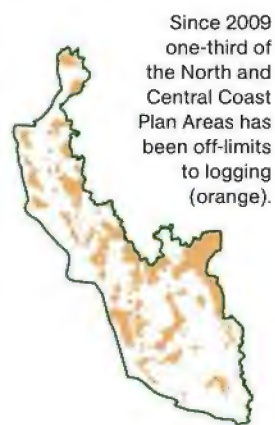
attract—about 220 a year. The government has already approved a fleet of liquefied natural gas tankers to call at nearby Kitimat in 2015. The oil tankers would be even bigger.

"I teach math at the school here," said Cameron Hill, a member of the Hartley Bay Band Council. "If I were to express the *Queen of the North* as an exponent, I'd say it was an x -squared disaster. The potential damage from those oil tankers is x to the 100th power."

WITH THE NORTHERN GATEWAY PROPOSAL, the Gitga'at and the rain forest that surrounds them have been caught up in a great geopolitical oil game. The Northern Gateway isn't just a pipeline. It's Canada's bid to become a global player in the petroleum market.

The proven reserves in Alberta's oil sands are second only to Saudi Arabia's oil fields, yet the United States today is virtually the sole export market for oil sands crude. A Canadian company, Enbridge, wants to build a \$5.8 billion (\$5.5 billion Canadian) pipeline to transport oil 731 miles, from Alberta to Kitimat. The double-barreled pipeline would carry oil west and send condensate, a liquid used to dilute the thick crude and allow it to flow, east to Alberta. Giant tankers—some nearly as long as the Empire State Building is tall, loaded with condensate or up to 2.15 million barrels of crude—would thread between a jigsaw of islands to and from Kitimat.

A West Coast oil port would open the Alberta oil sands to Asian markets, including China. Sinopec, China's state-owned oil company, is among the Asian refiners and



To reach the port of Kitimat, giant tankers would navigate through the heart of the Great Bear Rainforest. At the port they would load up on petroleum from Alberta's oil sands, transported via the proposed Northern Gateway pipeline.

Existing ship traffic



Ferry, 499 ft*



Handy class tanker, 623 ft



Cruise ship, 1,066 ft*

Proposed oil tankers into Kitimat

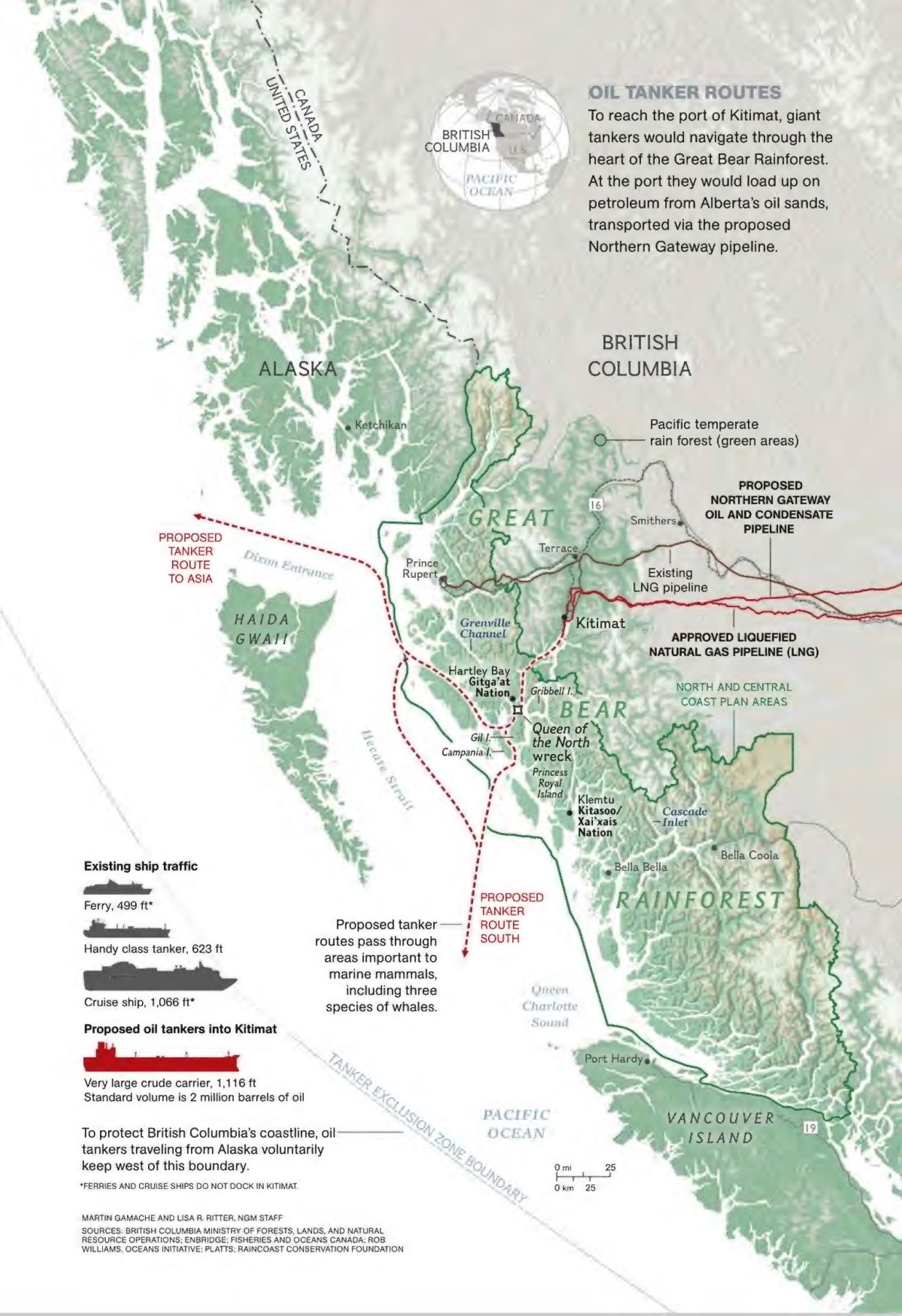


Very large crude carrier, 1,116 ft
Standard volume is 2 million barrels of oil

To protect British Columbia's coastline, oil tankers traveling from Alaska voluntarily keep west of this boundary.

*FERRIES AND CRUISE SHIPS DO NOT DOCK IN KITIMAT.

SOURCES: BRITISH COLUMBIA MINISTRY OF FORESTS, LANDS, AND NATURAL RESOURCE OPERATIONS; ENBRIDGE; FISHERIES AND OCEANS CANADA; ROB WILLIAMS, OCEANS INITIATIVE; PLATTS; RAINCOAST CONSERVATION FOUNDATION

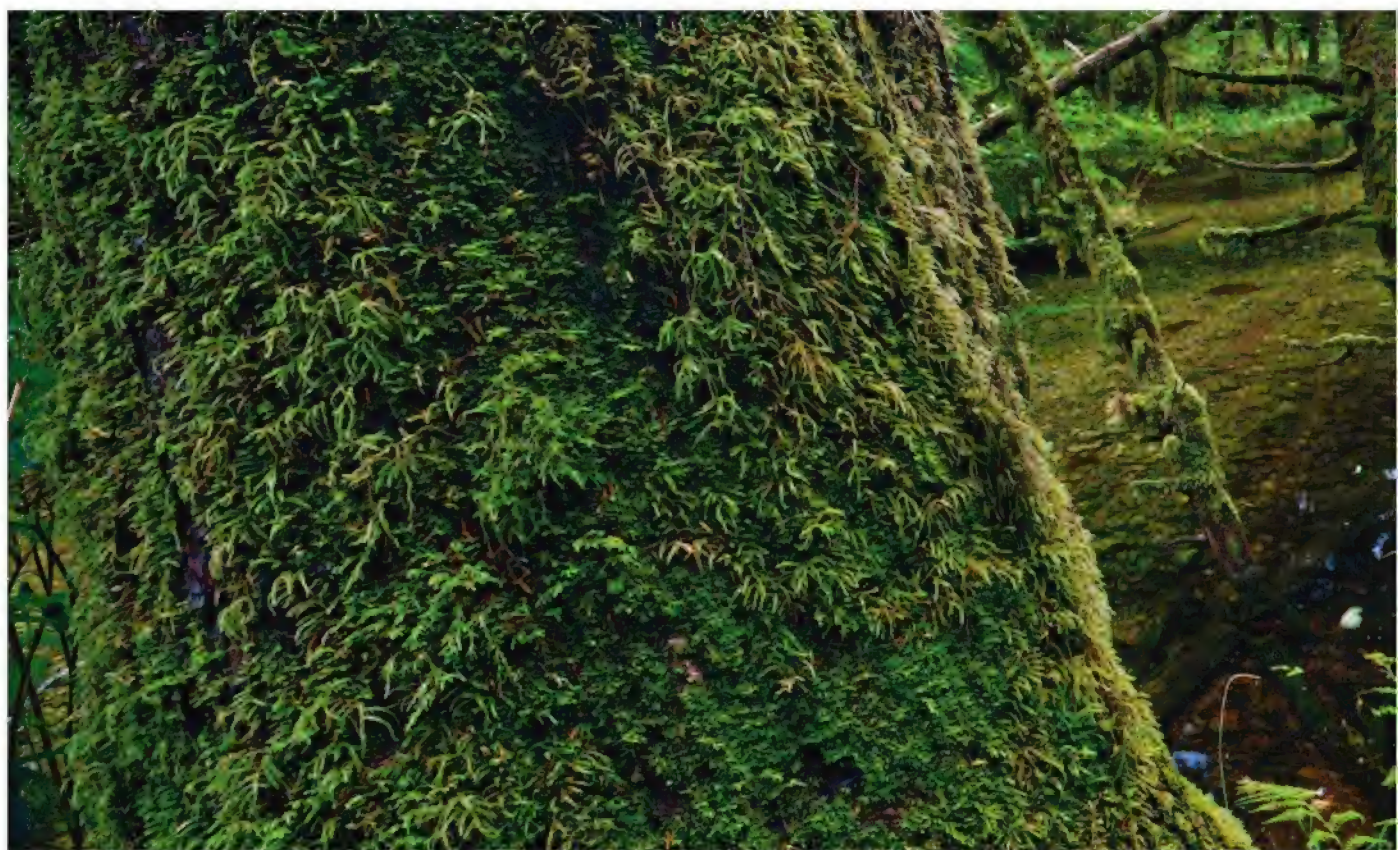




Since gaining legal protection in the 1970s, Steller sea lions in British Columbian and neighboring waters have tripled in population to about 30,000 during the summer breeding season.

THOMAS P. PESCHAK





Canadian oil firms that have invested \$105 million into moving the Northern Gateway pipeline through the planning and permitting stage.

"We think it is hugely in Canada's national best interest to have a second outlet for our crude oil," Enbridge CEO Patrick Daniel has said.

THE ISSUE IS NO LESS CRITICAL for the Great Bear Rainforest, a wild stretch of western red cedar, hemlock, and spruce forest that runs 250 miles down British Columbia's coast. Whales, wolves, bears, and humans thrive in the rich marine channels and forests of the Great Bear, whose boundaries have never been precisely defined. "We don't want another *Exxon Valdez* on our shores," said Doug Neasloss, a Kitasoo/Xai'xais wildlife guide and marine planner.

Neasloss has hardly known a time when the rain forest wasn't a battleground. "When I was growing up here in the 1990s, there were almost no jobs," he said. "The unemployment rate in my hometown of Klemtu was closing in on 90 percent." Timber companies offered jobs. But wages from those jobs bought clear-cuts

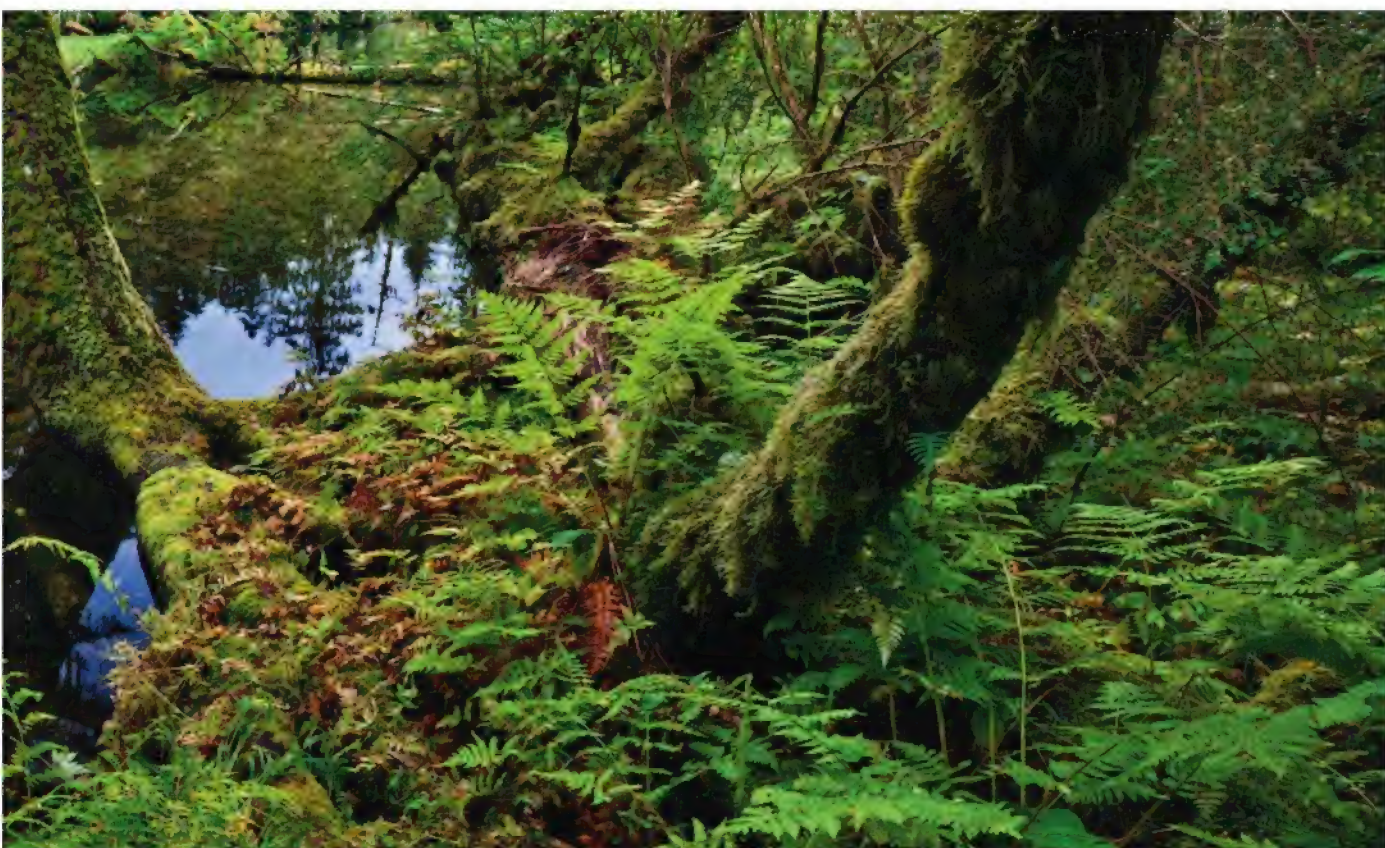
that reduced forests to stumps, destroying bear habitat and salmon spawning grounds.

In 1995 environmentalists began chaining themselves to trees and logging equipment to halt the cut. "Our community didn't welcome them at first," Neasloss recalled. "But then they all sat down and talked. Out of those discussions came the idea for the Great Bear Rainforest."

The battle continued for 15 years. By 2009 the province had put a third of the Great Bear off-limits to logging and the rest under ecosystem-based management. Areas are protected not only as parks but also as conservancies, where traditional activities can continue but industrial logging and development can't. A \$126 million fund was set up to provide seed money for both conservation and economic development projects.

Just as the timber war wound down, the tanker war began.

Many of the same environmental groups involved in the timber fight are now opposing the oil pipeline, as are many of Canada's First Nations. "This is one of the biggest environmental threats we've ever seen," said Ian McAllister, co-founder



The Great Bear's 25,000 square miles are a fourth of North America's coastal temperate rain forests.

of Pacific Wild, a wilderness protection organization that focuses on Canada's Pacific coast. "And it will become one of the biggest environmental battles Canada has ever witnessed. It's going to be a bare-knuckle fight."

The project is so big that the federal government has set up a joint review panel to oversee a two-year environmental assessment and permitting process, expected to conclude in late 2012.

THE FIGHT OVER THE PIPELINE contains more than a few echoes of the battle over the trans-Alaska pipeline in the late 1960s and early 1970s. Back then, Alaska natives' land claims threatened to stop the project in its tracks. The issue was ultimately decided by the Alaska Native Claims Settlement Act, the largest land-claim settlement in U.S. history, which gave money and land to Alaska-native village and regional corporations and allowed the pipeline to be built.


So far no similar deal seems to be in the works. Last year 61 Canadian First Nations announced they would not allow the proposed pipeline to cross their traditional territory. Whether they

have the legal authority to stop the pipeline is hard to say; aboriginal rights remain largely unsettled in British Columbia.

But that hasn't stopped Enbridge from courting the bands. "We want aboriginal economic participation in this project," said John Caruthers, president of Northern Gateway Pipelines. "We'd like them to own a stake that will establish a long-term benefit to First Nations communities." The company even offered financing to bring the bands aboard. So far there have been few takers.

"Buy in?" said Gitga'at council member Cameron Hill. "Buy in to what—to selling our way of life? We live off food from the land and sea here. We've been taught to respect what we take. That's sustained us from time immemorial. No amount of money can make us change our position."

The Canadian government's joint review panel is expected to mull over the issue for the next 18 months. Meanwhile, not far from Hill's home, the *Queen of the North* sends up an occasional burp of diesel fuel. In Hartley Bay the *Queen* may be dead, but she is not forgotten. □



Gray wolves often find good hunting in the intertidal zone, where they swim after black-tailed deer, fish snout-first for salmon in shallow creeks, consume seals, and scavenge herring eggs.

FLORIAN SCHULZ





Robotist Hiroshi Ishiguro of Osaka University built his own mechanical twin to see how humans react to extraordinarily lifelike machines.

Us.

And them.

Robots are being
created that can think,
act, and relate to humans.
Are we ready?



Domestic robots keep busy at the Korea Institute of Science and Technology. One makes toast, while the appropriately attired bot at right waits to deliver the toast to a human. At left, a third robot tests technology for navigating through a house, controlled by the movements of the researcher in the baseball cap.



Someone types a command into a laptop, and Actroid-DER jerks upright with a shudder and a wheeze. Compressed air flows beneath silicone skin, triggering actuators that raise her arms and lift the corners of her mouth into a demure smile. She seems to compose herself, her eyes panning the room where she stands fixed to a platform, tubes and wires running down through her ankles. She blinks, then turns her face toward me. I can't help but meet her—its—mechanical gaze. “Are you surprised that I’m a robot?” she



At Carnegie Mellon University the robot Actroid-DER took a crash course in becoming more human.

asks. "I look just like a human, don't I?"

Her scripted observation has the unfortunate effect of calling my attention to the many ways she does not. Developed in Japan by the Kokoro Company, the Actroid-DER android can be rented to serve as a futuristic spokesmodel at corporate events, a role that admittedly does not require great depth of character. But in spite of the \$250,000 spent on her development, she moves with a twitchy gracelessness, and the inelasticity of her features lends a slightly demented undertone to her lovely face. Then there is her habit of appearing to nod off momentarily between utterances, as if she were on something stronger than electricity.

While more advanced models of the Actroid make the rounds of technology exhibitions, this one has been shipped to Carnegie Mellon University in Pittsburgh to acquire the semblance of a personality. Such at least is the hope of five optimistic graduate students in the university's Entertainment Technology Center, who have been given one 15-week semester to render the fembot palpably more fem and less bot. They have begun by renaming her Yume—dream, in Japanese.

"Kokoro developed her to be physically realistic, but that's not enough by itself," says Christine Barnes, student co-producer of the Yume Project. "What we're going to do is shift the focus from realism to believability."

The Actroid androids are part of a new generation of robots, artificial beings designed to function not as programmed industrial machines but as increasingly autonomous agents capable of taking on roles in our homes, schools, and offices previously carried out only by humans. The foot soldiers of this vanguard are the Roomba vacuums that scuttle about cleaning our carpets and the cuddly electronic pets that sit up and roll over on command but never make a mess on the rug. More sophisticated bots may soon be available that cook for us, fold the laundry, even babysit our children or tend to our elderly parents, while we watch and assist from a computer miles away.

"In five or ten years robots will routinely be functioning in human environments," says Reid

Simmons, a professor of robotics at Carnegie Mellon.

Such a prospect leads to a cascade of questions. How much everyday human function do we want to outsource to machines? What should they look like? Do we want androids like Yume puttering about in our kitchens, or would a mechanical arm tethered to the backsplash do the job better, without creeping us out? How will the robot revolution change the way we relate to each other? A cuddly robotic baby seal developed in Japan to amuse seniors in eldercare centers has drawn charges that it could cut them off from other people. Similar fears have been voiced about future babysitting robots. And of course there are the halting attempts to create ever willing romantic androids. Last year a New Jersey company introduced a talking, touch-sensitive robot "companion," raising the possibility of another kind of human disconnect.

In short: Are we ready for them? Are they ready for us?

In a building a mile up the hill from the Entertainment Technology Center, HERB sits motionless, lost in thought. Short for Home Exploring Robotic Butler, HERB is being developed by Carnegie Mellon in collaboration with Intel Labs Pittsburgh as a prototype service bot that might care for the elderly and disabled in the not too distant future. HERB is a homely contraption, with Segway wheels for legs and a hodgepodge of computers for a body. But unlike pretty Yume, HERB has something akin to a mental life. Right now the robot is improving its functionality by running through alternative scenarios to manipulate representations of objects stored in its memory, tens of thousands of scenarios a second.

"I call it dreaming," says Siddhartha Srinivasa, HERB's builder and a professor at the Robotics Institute at Carnegie Mellon. "It helps people intuitively understand that the robot is actually visualizing itself doing something."

Traditional robots, the kind you might find spot-welding a car frame, can be programmed to carry out a very precise sequence of tasks but

only within rigidly structured environments. To negotiate human spaces, robots like HERB need to perceive and cope with unfamiliar objects and move about without bumping into people who are themselves in motion. HERB's perception system consists of a video camera and a laser navigation device mounted on a boom above his mechanical arm. ("We tend to think of HERB as a he," Srinivasa says. "Maybe because most butlers are. And he's kind of beefy.") In contrast to a hydraulic industrial robotic armature, HERB's arm is animated by a pressure-sensing system of cables akin to human tendons: a necessity if one wants a robot capable of supporting an elderly widow on her way to the bathroom without catapulting her through the door.

In the lab one of Srinivasa's students taps a button, issuing a command to pick up a juice box sitting on a nearby table. HERB's laser spins, creating a 3-D grid mapping the location of nearby people and objects, and the camera locks on a likely candidate for the target juice box. The robot slowly reaches over and takes hold of the box, keeping it upright. On command, he gently puts it down. To the uninitiated, the accomplishment might seem underwhelming. "When I showed it to my mom," Srinivasa says, "she couldn't understand why HERB has to think so hard to pick up a cup."

The problem is not with HERB but with the precedents that have been set for him. Picking up a drink is dead simple for people, whose brains have evolved over millions of years to coordinate exactly such tasks. It's also a snap for an industrial robot programmed for that specific action. The difference between a social robot like HERB and a conventional factory bot is that he knows that the object is a juice box and not a teacup or a glass of milk, which he would have to handle differently. How he understands this involves a great deal of mathematics and computer science, but it boils down to "taking in information and processing it intelligently in the context of everything he already knows about what his world looks like," Srinivasa explains.

When HERB is introduced to a new object, previously learned rules inform the movement

of his pressure-sensitive arm and hand. Does the object have a handle? Can it break or spill? Srinivasa programmed HERB's grips by studying how humans behave. In a bar, for instance, he watched bartenders use a counterintuitive underhanded maneuver to grab and pour from a bottle. He reduced the motion to an algorithm, and now HERB has it in his repertoire.

Of course the world HERB is beginning to master is a controlled laboratory environment. Programming him to function in real human spaces will be frightfully more challenging. HERB has a digital bicycle horn that he honks to let people know he's getting near them; if a room is busy and crowded, he takes the safest course of action and simply stands there, honking at everybody.

This strategy works in the lab but would not go over well in an office. Humans can draw on a vast unconscious vocabulary of movements—we know how to politely move around someone in our path, how to sense when we're invading someone's personal space. Studies at Carnegie Mellon and elsewhere have shown that people expect social robots to follow the same rules. We get uncomfortable when they don't or when they make stupid mistakes. Snackbot, another mobile robot under development at Carnegie Mellon, takes orders and delivers snacks to people at the School of Computer Science. Sometimes it annoyingly brings the wrong snack or gives the wrong change. People are more forgiving if the robot warns them first that it might make errors or apologizes when it screws up.

Then there are the vagaries of human nature to cope with. "Sometimes people steal snacks from the robot," says one of Snackbot's developers. "We got it on video."

Like many social robots, Snackbot is a cute fellow—four and a half feet tall, with a head and cartoonish features that suggest, barely, a

Chris Carroll covers the Pentagon for Stars and Stripes and has written frequently for National Geographic. Max Aguilera-Hellweg is drawn to stories at the intersection of science and humanity.





Nick Mayer, of the LifeNaut project in Vermont, sits down for a chat with the robotic head Bina48. Hanson Robotics created the talkative humanoid in the image of Bina Rothblatt, the co-founder of LifeNaut, which is exploring robot-human fusion as a technological path to immortality.

human being. In addition to lowering expectations, this avoids any trespass into the so-called uncanny valley, a term invented by pioneering Japanese roboticist Masahiro Mori more than 40 years ago. Up to a point, we respond positively to robots with a human appearance and motion, Mori observed, but when they get too close to lifelike without attaining it, what was endearing becomes repellent, fast.

Although most roboticists see no reason to tiptoe near that precipice, a few view the uncanny valley as terrain that needs to be crossed if we're ever going to get to the other side—a vision of robots that look, move, and act enough like us to inspire empathy again instead of disgust. Arguably the most intrepid of these

black hair and thoughtful scowl. Ishiguro, who also teaches at Osaka University two hours away, says he created the silicone doppelgänger so he could literally be in both places at once, controlling the robot through motion-capture sensors on his face so he/it can interact through the Internet with colleagues at ATR, while the mere he stays in Osaka to teach. Like other pioneers of HRI, Ishiguro is interested in pushing not just technological envelopes but philosophical ones as well. His androids are cognitive trial balloons, imperfect mirrors designed to reveal what is fundamentally human by creating ever more accurate approximations, observing how we react to them, and exploiting that response to fashion something even more convincing.

Sophisticated robots may soon cook for us, fold our laundry, even babysit our children.

explorers is Hiroshi Ishiguro, the driving force behind the uncanny valley girl Yume, aka Actroid-DER. Ishiguro has overseen the development of a host of innovative robots, some more disturbing than others, to explore this charged component of human-robot interaction (HRI). In just this past year he's been instrumental in creating a stunningly realistic replica of a Danish university professor called Geminoid DK, with goatee, stubble, and a winning smile, and a "telepresence" cell phone bot called Elfoid, about the size, shape, and quasi cuddliness of a human preemie. Once it's perfected, you'll be able to chat with a friend using her own Elfoid, and her doll phone's appendages will mimic your movements.

Ishiguro's most notorious creation so far is an earlier Geminoid model that is his own robotic twin. When I visit him in his lab at ATR Intelligent Robotics and Communication Laboratories in Kyoto, Japan, the two of them are dressed head to toe in black, the bot sitting in a chair behind Ishiguro, wearing an identical mane of

"You believe I'm real, and you believe that thing is not human," he says, gesturing back at his twin. "But this distinction will become more difficult as the technology advances. If you finally can't tell the difference, does it really matter if you're interacting with a human or machine?" An ideal use for his twin, he says, would be to put it at the faraway home of his mother, whom he rarely visits, so she could be with him more.

"Why would your mother accept a robot?" I ask.

Two faces scowl back at me. "Because it is myself," says one.

Before robotic versions of sons can interact with mothers the way real sons do, much more will be required than flawless mimicry. Witness the challenges HERB faces in navigating through simple human physical environments. Other robots are making tentative forays into the treacherous terrain of human mental states and emotions. Nilanjan Sarkar of Vanderbilt University and his former colleague Wendy

With no human coach at the controls, Virginia Tech's robot soccer team dribbled, passed, and scored its way into the 2010 RoboCup "kid-size" semifinal in Singapore. The tournament founders' goal is a robot team that will defeat the human World Cup champs by 2050.



Creepy yet cute, Osaka University's four-foot-tall Child-robot with Biomimetic Body is designed to learn like a child by watching and interacting with humans. Childhood development is increasingly the model for robotic intelligence, bypassing the need to laboriously program a robot for every likely situation.





Stone, now of the University of Washington, developed a prototype robotic system that plays a simple ball game with autistic children. The robot monitors a child's emotions by measuring minute changes in heartbeat, sweating, gaze, and other physiological signs, and when it senses boredom or aggravation, it changes the game until the signals indicate the child is having fun again. The system is not sophisticated enough yet for the complex linguistic and physical interplay of actual therapy. But it represents a first step toward replicating one of the benchmarks of humanity: knowing that others have thoughts and feelings, and adjusting your behavior in response to them.

In a 2007 paper provocatively entitled "What

of interest—it was being operated by another researcher—but the human subjects' response.

"More than half the people we tested said they agreed with Robovie that it was unfair to put him in the closet, which is a moral response," says Kahn.

That humans, especially children, might empathize with an unjustly treated robot is perhaps not surprising—after all, children bond with dolls and action figures. For a robot itself to be capable of making moral judgments seems a more distant goal. Can machines ever be constructed that possess a conscience, arguably the most uniquely human of human attributes?

An ethical sense would be most immediately useful in situations where human morals are

Robots are making forays into the treacherous terrain of human mental states and emotions.

Is a Human?" developmental psychologist Peter Kahn of the University of Washington, together with Ishiguro and other colleagues, proposed a set of nine other psychological benchmarks to measure success in designing humanlike robots. Their emphasis was not on the technical capabilities of robots but on how they're perceived and treated by humans.

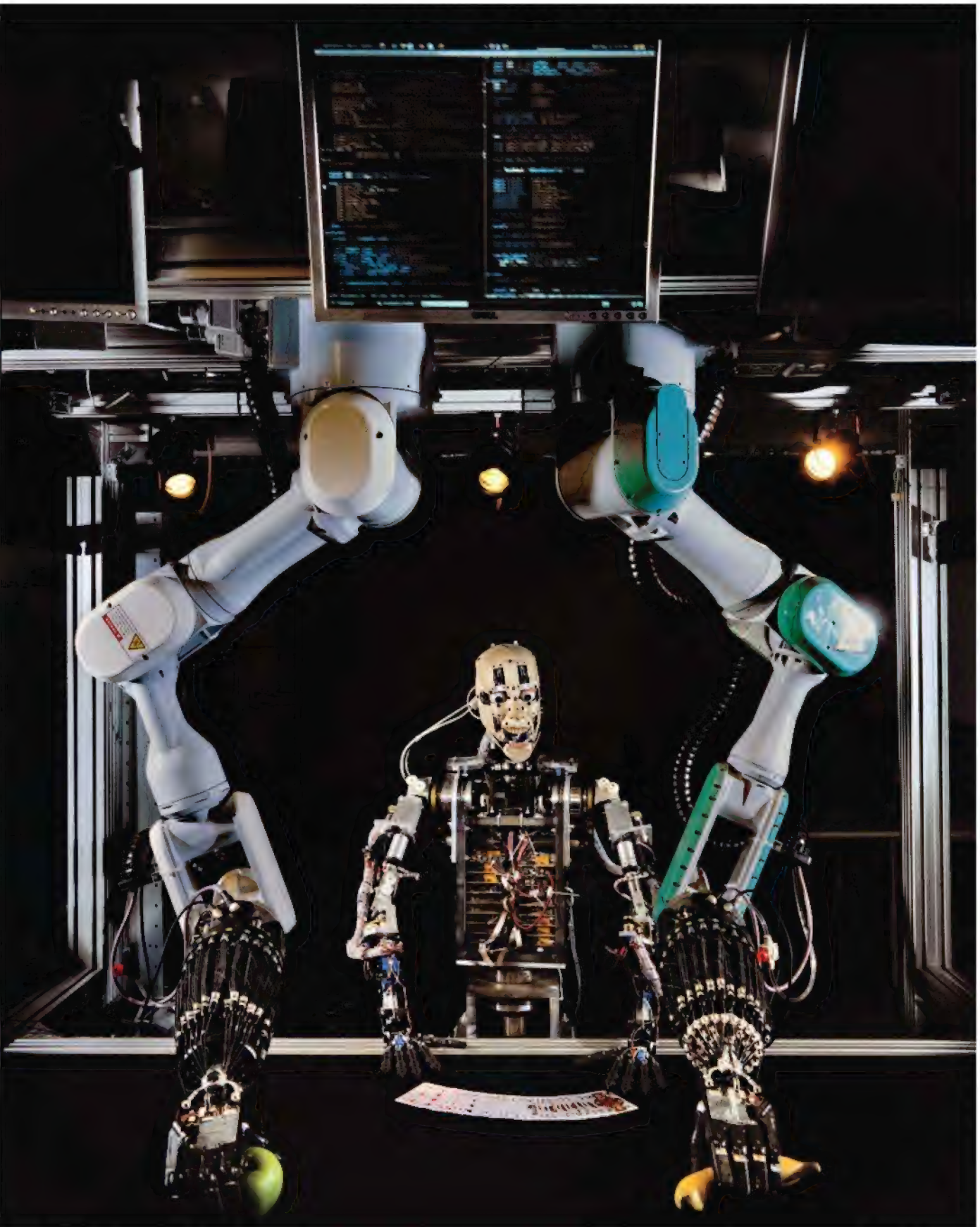
Consider the benchmark "intrinsic moral value"—whether we deem a robot worthy of the basic moral considerations we naturally grant other people. Kahn had children and adolescents play guessing games with a cute little humanoid named Robovie. After a few rounds an experimenter would abruptly interrupt just as it was Robovie's turn to guess, telling the robot the time had come to be put away in a closet. Robovie would protest, declaring it unfair that he wasn't being allowed to take his turn.

"You're just a robot. It doesn't matter," the experimenter answered. Robovie continued to protest forlornly as he was rolled away. Of course it wasn't the robot's reaction that was

continually put to the test—a battlefield, for example. Robots are being prepared for increasingly sophisticated roles in combat, in the form of remotely operated drones and ground-based vehicles mounted with machine guns and grenades. Various governments are developing models that one day may be able to decide on their own when—and at whom—to fire. It's hard to imagine holding a robot accountable for the consequences of making the wrong decision. But we would certainly want it to be equipped to make the right one.

The researcher who has gone the furthest in designing ethical robots is Ronald Arkin of the Georgia Institute of Technology in Atlanta. Arkin says it isn't the ethical limitations of robots in battle that inspire his work but the ethical limitations of human beings. He cites two incidents in Iraq, one in which U.S. helicopter pilots allegedly finished off wounded combatants, and another in which ambushed marines in the city of Haditha killed civilians. Influenced perhaps by fear or anger, the marines may have

Linked through a computer, the humanoid BARTHOC and a pair of robotic hands team up to learn from humans at Germany's Bielefeld University. The hands are being trained how to grasp different fruits, while BARTHOC provides a face for the researcher to address—a key part of human communication.





Ready to fire bullets and hurl grenades, a Modular Advanced Armed Robotic System, operated by a soldier behind cover, rolls into action in a training setup at Fort Benning, Georgia. Future military robots endowed with ethical programs might be able to decide on their own when, and at whom, to shoot.



“shot first and asked questions later, and women and children died as a result,” he says.

In the tumult of battle, robots wouldn’t be affected by volatile emotions. Consequently they’d be less likely to make mistakes under fire, Arkin believes, and less likely to strike at noncombatants. In short, they might make better ethical decisions than people.

In Arkin’s system a robot trying to determine whether or not to fire would be guided by an “ethical governor” built into its software. When a robot locked onto a target, the governor would check a set of preprogrammed constraints based on the rules of engagement and the laws of war. An enemy tank in a large field, for instance, would quite likely get the go-ahead; a funeral

to watch the Yume Project team unveil its transformed android to the Entertainment Technology Center’s faculty. It’s been a bumpy ride from realism to believability. Yan Lin, the team’s computer programmer, has devised a user-friendly software interface to more fluidly control Yume’s motions. But an attempt to endow the fembot with the ability to detect faces and make more realistic eye contact has been only half successful. First her eyes latch onto mine, then her head swings around in a mechanical two-step. To help obscure her herky-jerky movements and rickety eye contact, the team has imagined a character for Yume that would be inclined to act that way, with a costume to match—a young girl, according to the project’s

Can robots be constructed that possess a conscience, arguably the most human attribute?

at a cemetery attended by armed enemy combatants would be off-limits as a violation of the rules of engagement.

A second component, an “ethical adapter,” would restrict the robot’s weapons choices. If a too powerful weapon would cause unintended harm—say a missile might destroy an apartment building in addition to the tank—the ordnance would be off-limits until the system was adjusted. This is akin to a robotic model of guilt, Arkin says. Finally, he leaves room for human judgment through a “responsibility adviser,” a component that allows a person to override the conservatively programmed ethical governor if he or she decides the robot is too hesitant or is overreaching its authority. The system is not ready for real-world use, Arkin admits, but something he’s working on “to get the military looking at the ethical implications. And to get the international community to think about the issue.”

Back at Carnegie Mellon it’s the final week of the spring semester, and I have returned

blog, “slightly goth, slightly punk, all about getting your attention from across the room.”

That she certainly does. But in spite of her hip outfit—including the long fingerless gloves designed to hide her zombie-stiff hands and the dark lipstick that covers up her inability to ever quite close her mouth—underneath, she’s the same old Actroid-DER. At least now she knows her place. The team has learned the power of lowering expectations and given Yume a new spiel.

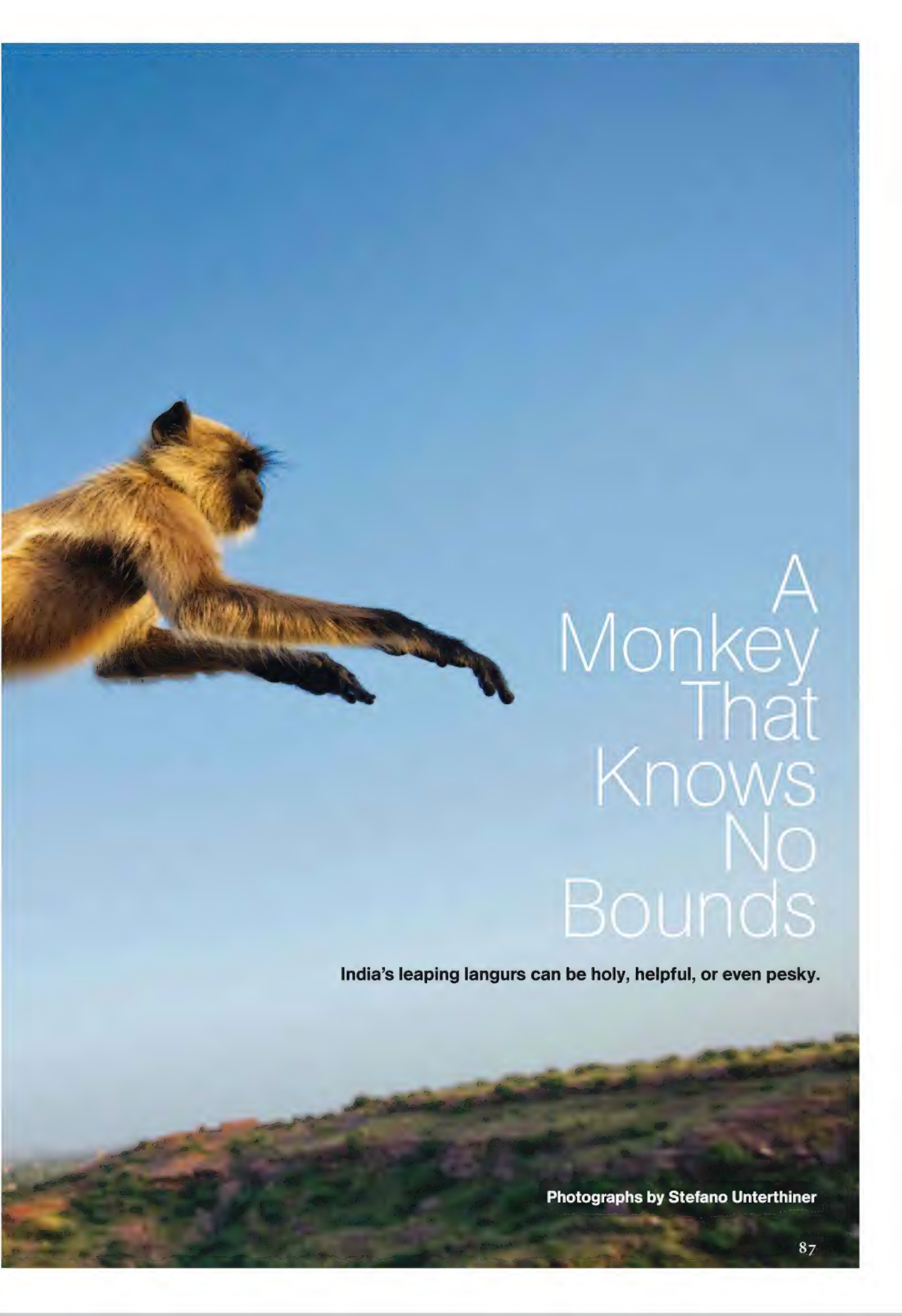
“I’m not human!” she confesses. “I’ll never be exactly like you. That isn’t so bad. Actually, I like being an android.” Impressed with her progress, the faculty gives the Yume team an A.

The next month technicians from the Kokoro Company come to pack Actroid-DER for shipment back to Tokyo. Christine Barnes, who’d unsuccessfully lobbied to keep the android at the Entertainment Technology Center, offers to cradle its lolling head as they maneuver it into a crate. The men politely decline. They unceremoniously seal Yume up, still wearing her funky costume. □

PR2 delivers mail at Willow Garage, a Silicon Valley firm that developed it as an easily customized research robot. Also tested as an eldercare aide, a cook, and a laundry folder, the versatile machine typifies a generation of robots set to emerge from controlled environments and enter the human world.



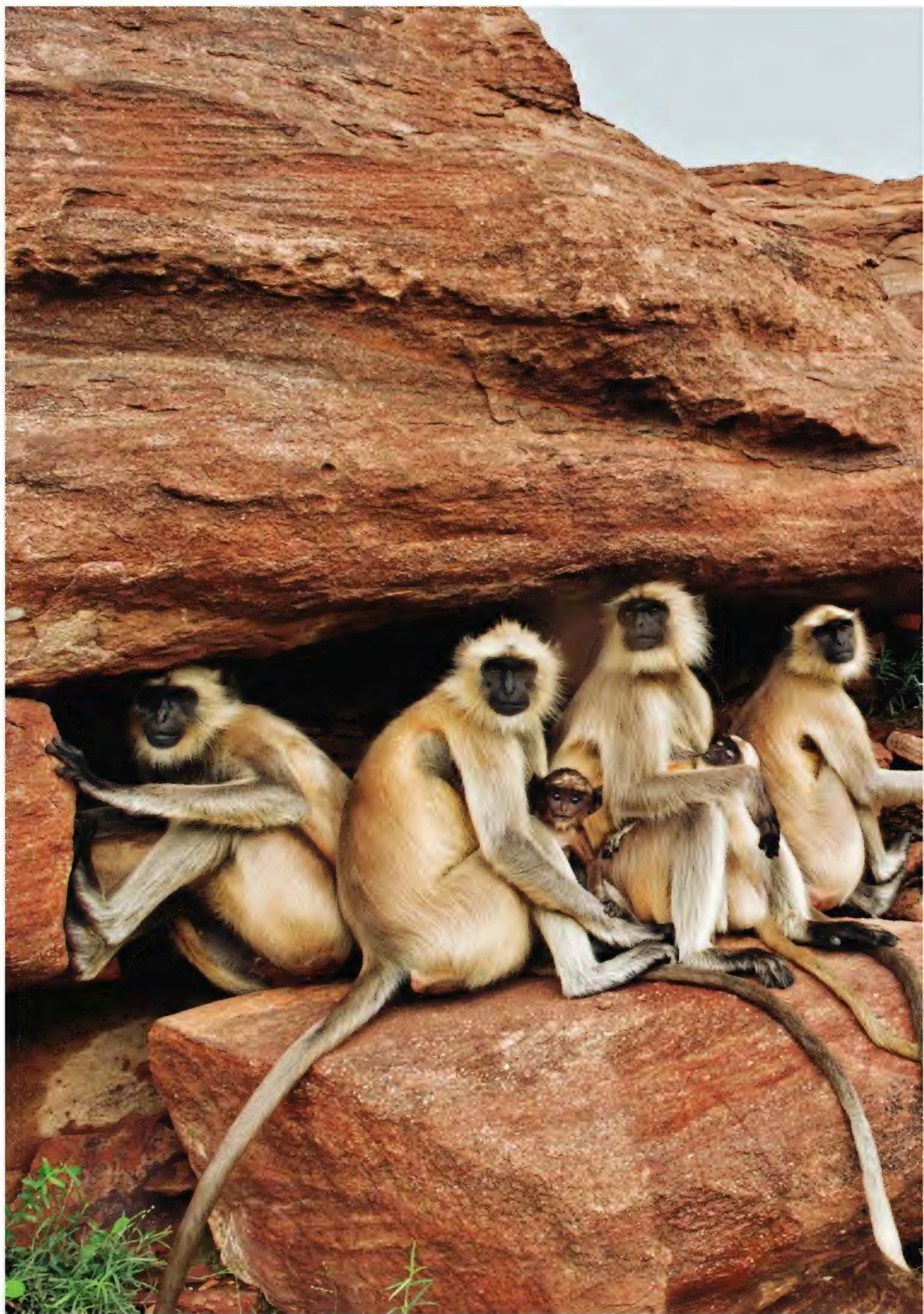




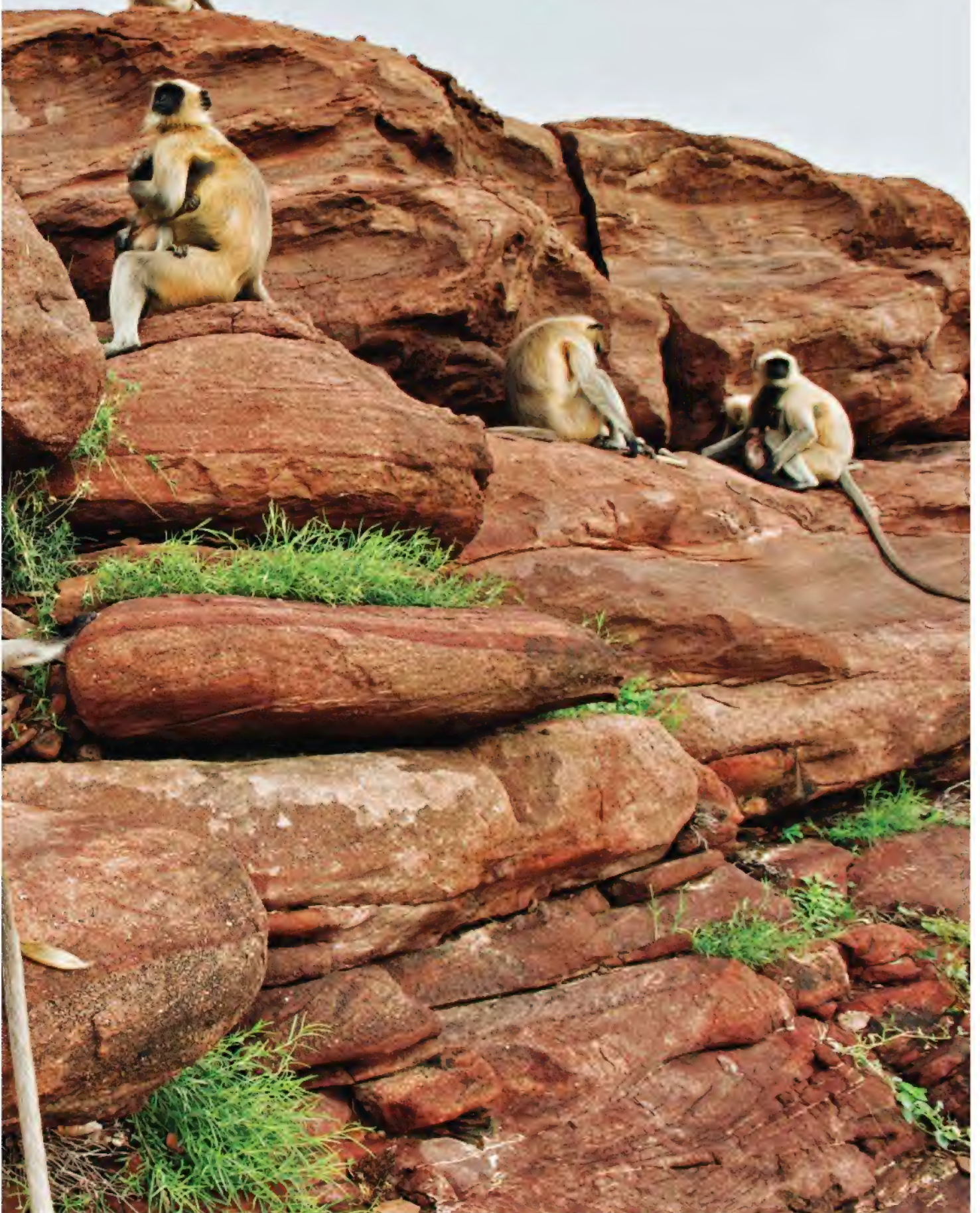
A Monkey That Knows No Bounds

India's leaping langurs can be holy, helpful, or even pesky.

Photographs by Stefano Unterthiner



Are these the monkeys' mothers? Not always. Langurs often share babysitting duties within a close-knit group of females and their offspring. The young are born with thin dark fur that turns thick and grayish gold after a few months.



In India monkey business takes on a whole new meaning. Hanuman langurs are trained in New Delhi to scare off aggressive rhesus monkeys and other wild animals that might roam into public spaces and cause mischief. When the city hosted the 2010 Commonwealth Games last October, its municipal council used 38 langurs to help with critter control.

These primates are valued as more than security guards. Hindus revere them as a symbol of the monkey deity Hanuman, whose simian army helped rescue Sita, the god Rama's wife, from a demon king, according to a Sanskrit epic. Langurs' black faces and extremities call to mind the burns that Hanuman suffered in the course of his heroism.

The lifestyle of the monkeys reflects this state of grace. In the city of Jodhpur, at the edge of the Thar, or Great Indian, Desert, some 2,100 wild langurs regularly leap into human society to sample its goods. Local Hindus share picnics in parks and turn shrines into buffets of offerings for the monkeys. Some let the holy beasts glean from their gardens.

That's a nice change of pace from life in the Thar, where sizzling heat and scant moisture make survival a challenge, and the monkeys must scrounge for plants and occasional insects to eat. Since most langurs are tree dwellers, these often scamper high on the desert cliffs or perch on nearby rooftops.

But the human population is growing fast in the region these days, and people may be tempted to retaliate if the monkeys' garden incursions turn into full-fledged crop raids. Even animals this beloved could wear out their welcome. —Jennifer S. Holland



NGM MAPS. SOURCE: DOUGLAS BRANDON-JONES

Population estimates

Total:
300,000
Jodhpur
population:
2,100



Stefano Unterthiner, a zoologist turned photographer, is a regular contributor to the magazine. Jennifer S. Holland is a senior staff writer.



A young male takes advantage of his holy status. Hundreds of Hanuman langurs, named for a Hindu god, roam freely in Mandor Garden, a historic park on the outskirts of Jodhpur. Picnic snacks—whether volunteered or snatched—are plentiful. But some humans regard the primates simply as a nuisance.

After a rare downpour langurs seek shelter from a fleeting desert waterfall. The Thar is usually inhospitably hot and dry, reaching 120°F. These monkeys, which are about two feet long and 25 to 40 pounds, are the only primates besides humans that thrive in this harsh habitat.







Long tails help langurs stay balanced on cliffs. They're also good for yanking; the observer above is missing a golden opportunity. Juveniles like those playing at right have a truly rough-and-tumble life. More than half of these monkeys are killed by disease, predators, or infanticide—common practice when a new male takes over a langur group—but survivors can live nearly 40 years.



Land of Shadows

As it emerges from isolation, the nation of Myanmar is caught between repression and reform, dark and light.



With rifles and shields, police patrol an industrial zone outside Yangon. Earlier, police had broken up a rare worker protest for better conditions and a wage increase equal to about ten dollars a month. A clandestine network of informants also monitors Burmese citizens.



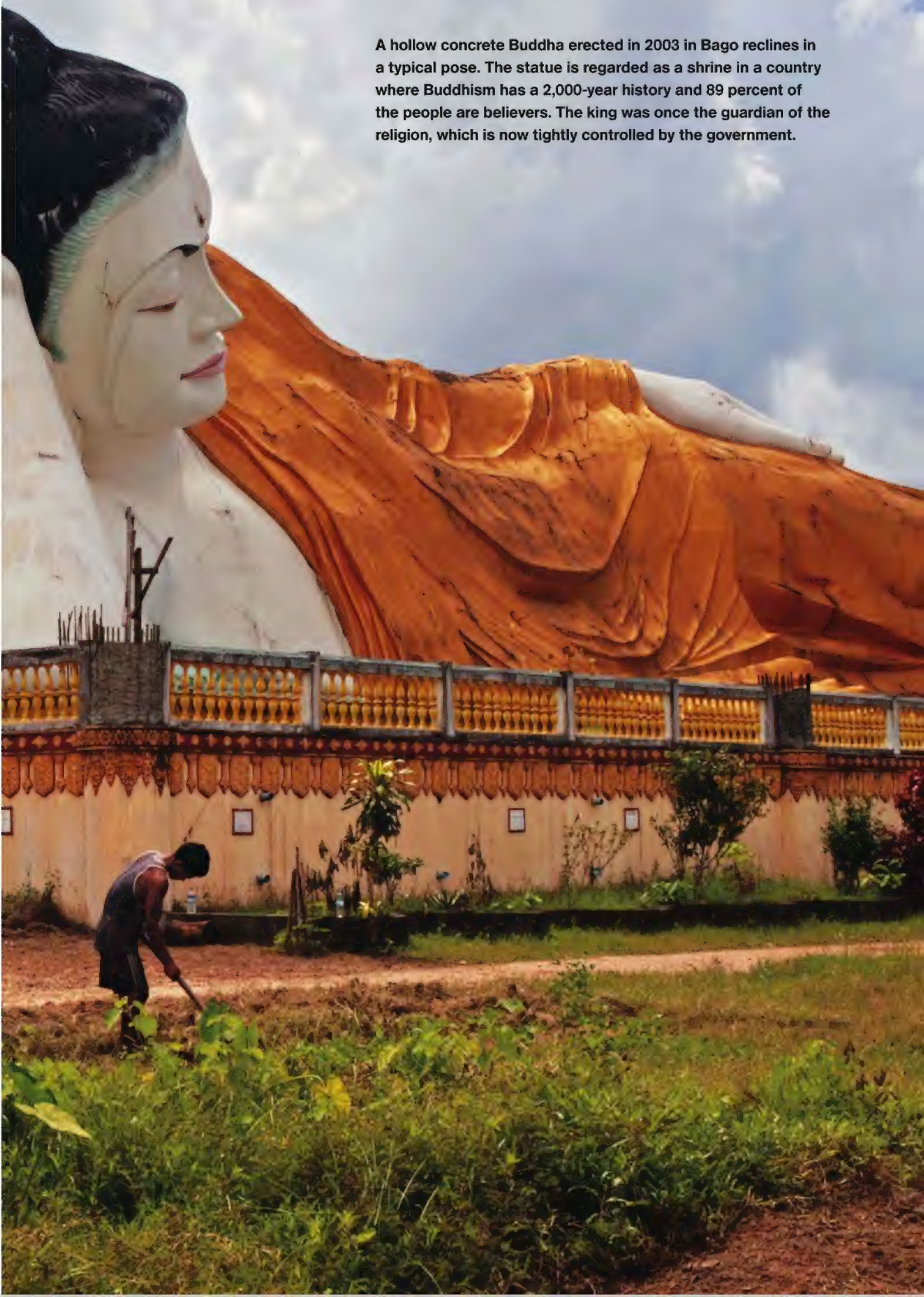


The picture on the cell phone at right is of Aung San Suu Kyi, leader of the opposition party, the National League of Democracy, and a revered figure in Myanmar. Those who display her image risk harassment. At left is Swedish model-actress Victoria Silvstedt, an icon of a different sort.





A hollow concrete Buddha erected in 2003 in Bago reclines in a typical pose. The statue is regarded as a shrine in a country where Buddhism has a 2,000-year history and 89 percent of the people are believers. The king was once the guardian of the religion, which is now tightly controlled by the government.



By Brook Larmer

Photographs by Chien-Chi Chang

It's the magic hour in Yangon,

when the last rays of sunlight, softer, cooler now, bathe the crumbling downtown in a golden glow, beckoning residents out into the streets. Giggling children race to buy fresh sugarcane juice. Women with cheeks daubed with a paste made of bark—the alluring Burmese sunblock—haggle with a fishmonger. In the street, bare-chested teenage boys in a circle play a rowdy game of chinlon, a sort of acrobatic Hacky Sack, while potbellied men in T-shirts and longyi,

the traditional Burmese sarong, sit on the sidewalk chewing red wads of betel nut.

The carnival-like atmosphere doesn't last. Night falls fast in the tropics, and the power shortages that plague Myanmar give the sudden transition a spooky edge. A decaying colonial-era government building goes black. The alleyway next door emits the bluish glow of television sets powered by portable generators. Under the trees the vendors are invisible, but candles illuminate their wares: circles of silvery fish, clusters of purple banana flowers, stacks of betel leaves. And lined up in a blue wooden case, pirated DVDs of American movies and music.

“Welcome to the Hotel California,” calls out a voice from the shadows in perfect English. Three young men sit on plastic stools in the street, laughing at the greeting. The DVD vendor, a skinny 29-year-old with wire-rimmed glasses and a pink button-down shirt, leaps up with a smile. Though his schooling ended in fourth grade, he speaks English in an eruption of phrases gleaned from Hollywood movies and 1950s grammar books. Meeting an American, he says, makes him feel “over the moon, on cloud nine, pleased as punch.”

The three “bosom buddies”—Tom, Dick, and Harry, as they call themselves—meet almost





Billboards show how consumer culture is taking hold in Yangon, the former capital known as Rangoon. The city is a bustling commercial center, yet the layers of its past are still evident in religious structures like the 2,000-year-old Sule Pagoda (center rear) and in the British colonial architecture.

every evening to practice their English idioms. Tonight, over cups of milky tea, they will banter for hours, showing off new expressions like nuggets of gold. Now, in the dark, the three friends hesitate for a minute, puzzling over the lyrics of an old Eagles hit. “Hey, maybe you can help,” Tom says. “What do they mean when they say, ‘We are all just prisoners here of our own device?’”

Myanmar is a land of shadows, a place where even the most innocent question can seem loaded with hidden intent. For most of the past half century this largely Buddhist nation of some 50 million has been shaped by the power—and

Beijing-based writer Brook Larmer is the author of Operation Yao Ming. Chien-Chi Chang’s most recent books are The Chain and Double Happiness.

By pulling Myanmar into isolation, the generals accelerated the decline of what was once “the jewel of Asia.” They have made it a pariah nation.

paranoia—of its military leaders. The *tatmadaw*, as the national military is known, was the only institution capable of imposing its authority on a fractured country in the wake of independence from Britain. It did so, in part, by pulling Myanmar into a fearful isolation, from which it is only starting to emerge.

This isolation, deepened by two decades of Western economic sanctions, may have preserved the nostalgic image of Myanmar as a country frozen in time, with its mist-shrouded lakes, ancient temples, and blend of traditional cultures largely unspoiled by the modern world. But it also helped accelerate the decline of what was once referred to as “the jewel of Asia.” Myanmar’s health and education systems have been gutted, while the military—with some 400,000 soldiers—drains nearly a quarter of the national budget. Most notoriously, the *tatmadaw*’s brutal suppression of ethnic insurgencies and civil opposition has made Myanmar a pariah nation, a distinction it now seems eager to shed.

Out of this tableau of darkness have come some fleeting rays of light. The country’s first parliamentary election in 20 years, held last November, heralded the advent of what military leaders call “discipline-flourishing democracy.” Though marred by widespread fraud and intimidation, the elections have given Myanmar its first nominally civilian government in half a century. Longtime military strongman Than Shwe officially retired in April, even though the new president is none other than his loyal deputy former Gen. Thein Sein, who has exchanged his army uniform for civilian clothes.

If one of the regime’s election goals was to win legitimacy at home and abroad, another was to erase the memory of the 1990 elections. In those polls, held two years after the *tatmadaw* gunned

down hundreds of antigovernment protesters, the junta denied the sweeping victory of the main opposition party, the National League of Democracy (NLD). Then for much of the next two decades, it put top opposition figures in prison and kept under house arrest the party’s leader, Aung San Suu Kyi.

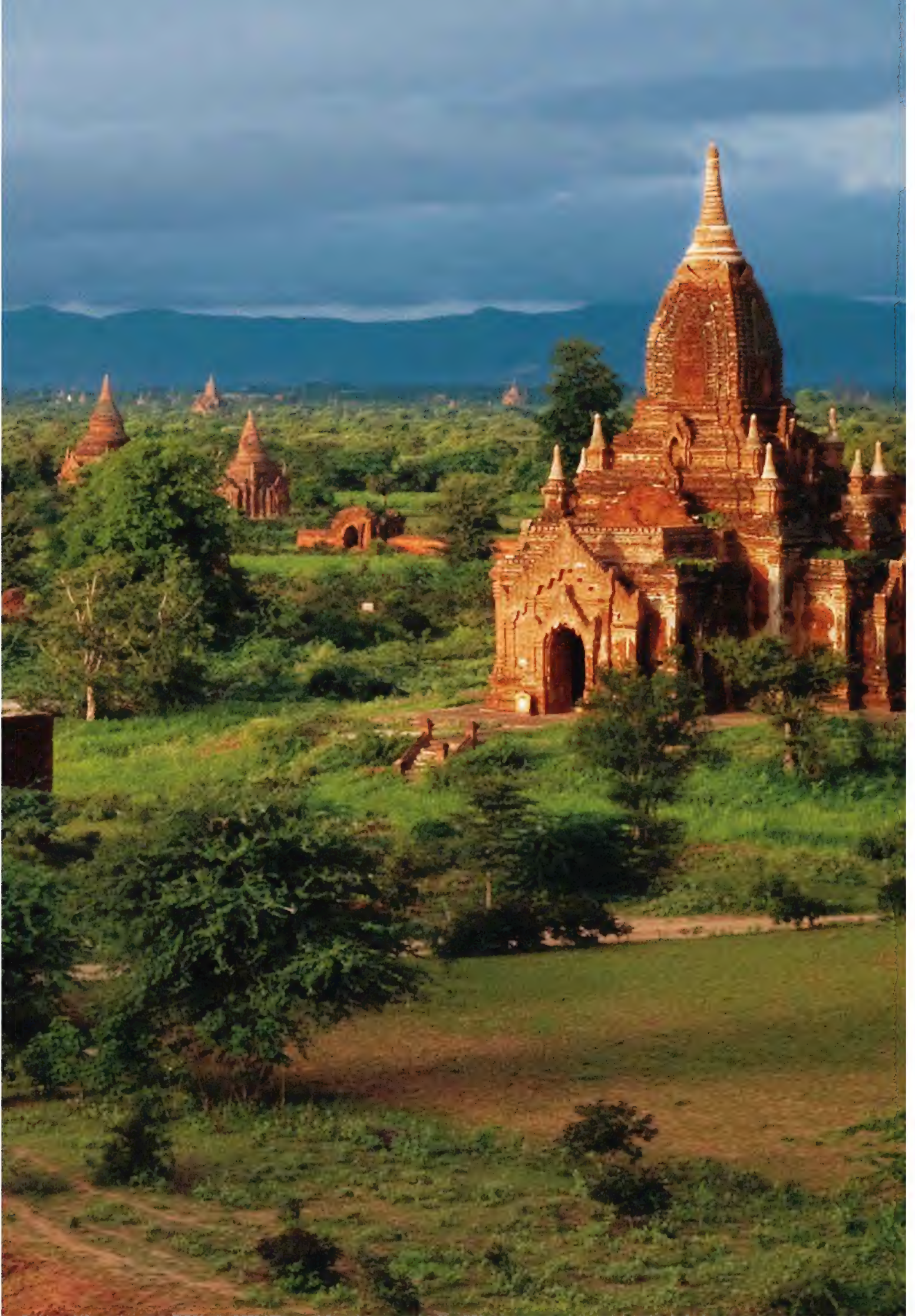
The Lady, as she is known, pushed the NLD to boycott last November’s polls, which she, then still under house arrest, was barred from participating in. Joining such an “unfair” exercise, she argued, would give legitimacy to a regime that in 2007 again resorted to lethal violence—firing on protesting Buddhist monks—and a year later neglected the victims of Cyclone Nargis. That catastrophe left approximately 140,000 dead and nearly a million homeless. Not everybody agreed with Suu Kyi; some opposition figures believed that the transition to civilian rule, however flawed, offered their last hope to remain relevant.

Less than a week after the 2010 election, as military-backed parties claimed an overwhelming victory, came another glimmer of hope: Suu Kyi’s release. Then 65, the Nobel laureate had spent 15 of the previous 21 years in detention, and the world rejoiced at her freedom. The sight of the Lady thronged by young followers led some to believe that a new era was dawning. But Suu Kyi harbors no such illusions. “Society has changed enormously,” she said, marveling at the ubiquity of mobile phones, Twitter, and Facebook when I interviewed her in February. “But politically, there is no difference at all.”

It is tempting to see Myanmar as a simple morality tale, a battle between light and darkness. But the Lady and the generals don’t represent the only poles vying for the country’s future. Within the ranks of both the military and the opposition there are voices, still muted, pushing for greater flexibility and reform. Beyond this contest among the elites, there are the ethnic minorities, who make up about a third of the population and occupy more than half the territory. The question of how to govern this kaleidoscope of restive groups has vexed Burmese rulers since the time of the ancient kings, and any real progress will depend on their

A monk walks a dusty road in Bagan, the ancient capital—and a sight to rival Cambodia's Angkor Wat. The area once held 13,000 pagodas dating back to the second century A.D., many built of brick that was plastered and painted. Earthquakes and the Ayeyarwady River destroyed more than 10,000 of them.







Opposition leader and Nobel laureate Aung San Suu Kyi holds Taichido, a gift from her younger son, as she talks with adviser Win Htein at her house in Yangon. Having spent 15 of the previous 21 years under detention, she was released again last November. Months earlier Win Htein was released after 20 years in jail. The junta, ever paranoid, moved the government in 2005 from coastal Yangon to a harder-to-invade spot mid-country. To legitimize the lavish new capital, Nay Pyi Taw, officials built a copy (top right) of Yangon's venerated Shwedagon Pagoda. In 2007 Buddhist monks led antigovernment protests that came to be called the Saffron Revolution. In a monastery (bottom right) devout young Buddhists double up on showers and laundry.



accommodation. "If the ethnic groups are left out of the equation," one foreign diplomat says, "this place could fall apart."

The stakes for Myanmar's future are higher than ever, in part because the country—wedged between China and India—has again become a geopolitical chess piece. Even as the United States and other Western governments continue imposing sanctions to punish the regime for its human rights violations, China, Thailand, and other competing Asian powers have poured money into Myanmar to exploit its resources—oil and gas, timber, gems, minerals, and hydro-power. The foreign investment, worth billions of dollars a year, has blunted the impact of sanctions but inflamed tensions in some ethnic areas where resources are most plentiful. Nothing yet has shaken the government's grip on power—or the fear and paranoia it inspires. But Myanmar, finally, is coming out of hibernation.

THE BAREFOOT MAGICIAN twirls a rope around a volunteer's neck, and the audience hushes in anticipation. Rows of gaping boys and girls stretch back to the entrance of the dilapidated building. Across the street outside, men lingering in an open-air tea shop crane to see. Myanmar is a country infused with magic, a place where animistic spirits, called *nats*, inhabit every banyan tree, where astrologers are called upon to guide key decisions. The magician knows, even if the children do not, that some of the men standing outside are not part of the invited audience but spies for the police's Special Branch.

This, after all, is no ordinary magic show. Sitting in the front row, a ring of jasmine flowers in her hair, is the Lady herself, Aung San Suu Kyi. It is Children's Day at the NLD's Yangon headquarters, an event timed to coincide with the birthday of Suu Kyi's father, Burmese independence hero Gen. Aung San, who was assassinated in 1947. Images of father and daughter—strikingly similar, save for his military uniform—hang above the NLD's entrance, along side walls, and in laminated pins on the shirts of children in the audience.

But now all eyes are on the magician slowly

weaving the rope around the volunteer's legs, arms, and torso, and even through his clothes. A young girl shoots a glance at Suu Kyi, who winks back in reassurance. This man is not a real prisoner, her smile suggests, even if the party elders flanking her have each spent more than a decade in the junta's jails. The magician barks out an instruction, and with a sudden yank, the rope snaps away. The prisoner is set free. Cheers fill the room, and Suu Kyi, tossing her head back, lets out an unbridled laugh.

If only it were that easy. Even with her freedom restored, Suu Kyi still seems bound by invisible tethers. The global icon is not simply





Myanmar has an official military, but this is not it. The Kachin Independence Army was mounted by one of the country's 135 ethnic minorities, all of whom prize their identities. The armies seek to maintain the autonomy of their resource-rich homelands in the face of interference from the regime.

burdened with high expectations. Her party is in limbo. Banned for boycotting last year's election, the NLD now runs the risk of violating the country's restrictive association laws with every gathering it holds. Even with the Children's Day event, says Win Htein, one of Suu Kyi's closest confidants, "we're defying restrictions."

From her office on the second floor of a building overlooking a busy street near the heart of

Yangon, Suu Kyi can see the Special Branch men in the tea shop across the way. "I don't know why they bother," she sighs. Despite a trace of nostalgia for her privacy—"I keep wondering when I'll have time to read and think again," she says—Suu Kyi has thrown herself into a whirlwind of meetings with diplomats, journalists, ethnic groups, civic organizations. So far, though, the men she needs to meet most—the



Women from both city and countryside strut a runway in a fashion show at a bar in Mandalay, where men in the audience pass flowers to women they fancy. Some observers believe that events like this are part of an illegal but increasingly overt prostitution scene in Myanmar.



Cartoons in the state-run media have depicted Aung San Suu Kyi as an evil ogre. In February an official newspaper warned that she and her party would “meet their tragic ends.”

generals—have ignored her overtures. “We keep the door open,” Suu Kyi says. “Nothing will be accomplished without dialogue.”

Over the years cartoons in the state-run media have depicted the elegant Lady as an evil ogre with fangs, feeding on Western handouts. The attacks ceased for a few months after her release. But when the NLD issued a statement in February defending Western sanctions against the regime, an editorial in an official newspaper, the *New Light of Myanmar*, warned that Suu Kyi and her party would “meet their tragic ends.” A rhetorical threat, perhaps, but few can forget the attack on her convoy the last time she was free, in 2003; it left at least a dozen followers dead.

Sanctions may be one of Suu Kyi’s last cards. A wide spectrum of international observers—including U.S. Secretary of State Hillary Clinton—has judged sanctions ineffective in Myanmar, largely because other countries, such as China, have no qualms about doing business with the government. “We’re willing to compromise,” Suu Kyi insists. But after two decades of sacrifice, she won’t call for an easing of sanctions unless there are serious concessions, starting with the release of Myanmar’s more than 2,000 political prisoners. “If sanctions are not effective,” she asks archly, “then why are the regime and its friends so desperate to see them disappear?” It seems that the government covets the one thing the Lady has that it has never possessed: legitimacy in the eyes of the world.

IF YOU COME TO NAY PYI TAW looking for clues about Myanmar’s leadership, the first thing you’ll find is an unsettling void: smooth ten-lane roads with manicured roundabouts but scarcely any vehicles, clusters of color-coded government housing complexes with no children in sight, a

copy of Yangon’s Shwedagon Pagoda with not a single Buddhist monk chanting prayers. It all feels like an abandoned movie set until you drive toward the military zone, an off-limits area where Than Shwe keeps his home and secretive high command. There, beyond the rumbling army trucks and the vast parade ground, stand the symbols of the regime: massive statues of Myanmar’s three most revered ancient kings.

Welcome to the Abode of Kings, Myanmar’s capital as of 2005, a strange utopia built on fear and hubris. A former mailman who honed his skills in the army’s psychological-warfare department, Than Shwe self-consciously assumed the mantle of Myanmar’s ancient monarchs—to the point where supplicants reportedly must use a royal form of Burmese to address him and his wife. Myanmar’s kings had a penchant for building new capitals as legacies of their rule, from the pagodas at Bagan to the royal palace in Mandalay. Now there’s Nay Pyi Taw.

The new capital may feel soulless, but for rulers distrustful of their own people, it could be a masterpiece of defensive urban planning. Worried about an imminent attack in Yangon, Than Shwe poured several billion dollars into building the city on scrubland in central Myanmar, safe from killer storms, foreign invasion, and domestic protests. In design, Nay Pyi Taw is not really a city but a series of isolated zones dispersed over an area larger than Rhode Island. Government ministries, once clustered in crowded Yangon, are laid out at wide intervals, accessible only by heavily patrolled roads. The military zone is a bubble within a bubble, forbidden to all but top officers—and reportedly honeycombed with underground bunkers.

In a city built by construction workers earning less than a dollar a day, the generals have splurged on some extravagances: an Olympic-size soccer stadium, a zoo equipped with an air-conditioned penguin house, a safari park, even a 480-acre “landmark garden” with miniature reproductions of Myanmar’s most famous sites, including wooden houses inhabited, on occasion, by ethnic minorities in native garb—a sort of human zoo.

The generals' obsession with one legacy of British colonialism—golf—has spawned five new courses. The farmers whose village was bulldozed to build the City Golf Course now weed fairways on their ancestral land—and smile deferentially when officials play through. Beyond its elitist appeal, the golf course provides a refuge where business deals are quietly negotiated, with bribes purportedly masked as losing bets. A 26-year-old female caddy wearing bright red lipstick has learned the rules of discretion. "I'm only supposed to smile," she says.

The capital does have one concession to democracy: a parliament complex consisting of 28 gargantuan pagoda-topped buildings rising above two faux suspension bridges. When parliament opened in February—the first session in 22 years—the 659 new MPs were herded into this self-contained world and kept in isolation for weeks. No media or spectators were allowed; the MPs themselves were forbidden to use mobile phones or email. "It was sad and funny," a Burmese businessman in Yangon says. "Here were all these MPs launching a new democracy, and yet they were huddled there like prisoners."

DEEP IN THE HILLS of northeastern Myanmar a young woman in a bamboo hat walks along a riverbank toward a sacred place: the convergence of two rivers that gives birth to the Ayeyarwady (known to the outside world as the Irrawaddy), the lifeblood of the nation. This spot is revered by Burmese of all faiths. But it is woven into the very identity of the ethnic Kachin minority, whose ancestors settled in this area centuries ago. At her wedding the Kachin woman and her husband (who asked not to be named) promised to emulate the union of the Mali and Nmai Rivers. Her family still comes to the confluence to make offerings on the first morning of each new year. "It's in our blood," she says.

All this will soon be gone. Around the Ayeyarwady's next bend Chinese workers are laying the groundwork for a 500-foot-tall hydroelectric dam, the first—and biggest—of seven dams slated to be built. Part of a joint venture between China Power Investment (CPI) and Myanmar's

regime-friendly Asia World, the Myitsone Dam is expected to have a generating capacity of 6,000 megawatts of electricity, more than the country as a whole now produces. By the time the dam is finished in 2019, it will flood an area larger than New York City, wiping out dozens of villages, including Tang Hpre, where the Kachin woman lives. From the riverbank she points to a white sign on a nearby hill. "The water will rise that high. Can you imagine living under that threat?"

Anger about the dam reverberates far beyond Tang Hpre. "The dam has become a rallying cry for the Kachin people," says Brig. Gen. Gun Maw of the Kachin Independence Army (KIA), a rebel group whose 17-year-old cease-fire with the Burmese government began unraveling late last year. Along with soldiers from other ethnic groups, the KIA has resisted the regime's demand that it re-form itself into a border-defense force under Burmese military command. The dam controversy only fuels the rising tension. "For months we've been asking Burmese authorities to clarify where the electricity will go, but we've received no reply," the 49-year-old rebel chief says. "I think we all know. China is very hungry for electric power." Indeed, according to a CPI document, most of the electricity will go directly to China.

Of all the foreign countries rushing in to exploit Myanmar's resources, China has been the most aggressive. Part of its nearly ten billion dollars in direct investment is going to the construction of pipelines to carry oil and gas from the Burmese coast to the Chinese border—a shortcut that also hedges against the risk of shipping through the narrow and pirate-infested Strait of Malacca. In Kachin State, which shares more than 600 miles of that border, Chinese companies are rushing in to extract gold, jade, and teak, as well as hydropower. As one Kachin activist says, "The Chinese won't stop until they've sucked us dry."

For the past year and a half the Burmese government has been demanding that Tang Hpre's 1,400 villagers move to a new settlement ten miles away to make way for the dam. Defiance has been virtually unanimous. Last year a series





A mother tends to her son, Kyaw Kyaw Win, 33 and HIV-positive, in an AIDS hospital outside Yangon (top left). He later died. Today some 240,000 Burmese live with HIV/AIDS, often a result of intravenous drug use; the death rate is 17,000 a year. A small budget for antiviral drugs makes AIDS “a relatively fatal condition,” notes Johns Hopkins epidemiologist Chris Beyrer. Myanmar spends nearly two times more on defense than on health and education. Beggars of all ages are common at the Maha Myat Muni Pagoda in Mandalay (bottom left). A woman spared by Cyclone Nargis—which killed three-quarters of tiny Pyinsalu’s inhabitants in 2008—is working on a new school (above) that will also serve as a cyclone shelter. The government has been slow to help people rebuild.

of bomb blasts hit dam-related sites across the valley, forcing several hundred Chinese workers to evacuate and delaying the project. The authorities arrested 70 Kachin youths in connection with the bombings. The woman in the bamboo hat insists that her resistance is nonviolent. "The government tells us not to fix up our homes, to let them crumble," she says. "But no, that only makes us determined to make them more beautiful than ever, to show that we will not move, even under threat of death."

Down on the bank of the Ayeyarwady, she peers into a deep pit of sand and rock. Her mission today is not to pray or protest but to join the search for gold. "Try over here," she instructs a Kachin teenager blasting the sand bank with a hose, as youngsters shovel the loosened sand onto an inclined ramp. Over the past few months villagers have noticed more boats full of Burmese and Chinese workers heading upriver to dredge for gold. She wonders if Tang Hpre's forced resettlement is a ploy to let the Chinese control another of the Kachins' precious resources. "We don't want to lose our home," she says. "But we need to get as much gold as we can before the Chinese come and the waters rise. This is ours."

FOR A MOMENT the loquacious DVD vendor is at a loss for words. Tom and his two young friends have been chatting in the dark about the glories of Yangon—its ethnic diversity, its hip-hop scene, its crumbling colonial architecture—when the subject turns, inevitably, to the future.

"I'm sweating bullets," Tom finally says. It's not just a new expression he's trying out. Recent power cuts have hurt the meager profits he brings in for his wife and daughter—about \$50 a month—and having a black market job makes him jittery. Even with the protection money he pays the cops, he barely escaped a recent police sweep. Were it not for his fleet feet, he might have wound up in jail and lost his inventory, including a prized Tom Cruise compilation disk. The *Top Gun* star, he says, is "the apple of my eyes."

Later, chewing on a wad of betel nut, Tom confides his great ambition: He wants to go

abroad. In this desire he is not alone. Each year tens of thousands of Burmese laborers head to Singapore and Malaysia, where they can earn upwards of \$300 a month. Dick, an underemployed English teacher, says he may try to find a sales job in Singapore. Tom has the U.S. in mind. "It is the land of milk and honey," he says. "And Angelina Jolie."

Even with his ebullient English, Tom's lack of





In Lashio a satellite dish and fancy toy car are signs that this family, which fled China during the Cultural Revolution, is part of Myanmar's very small middle class. Economists say the country has a "resource curse"—the rulers make money from resources but don't share it. Most people eke out a survival living.

higher education and financial assets dims his chances for a U.S. visa. But he seems so intoxicated by the idea—or is it the betel nut?—that he loses his inhibitions. “Under this dictatorship we live like pigs snorting in the dark!”

The outburst unnerves his friends. “He’s shooting off his mouth,” Dick whispers when Tom goes off to deal with a customer. “He shouldn’t be airing his dirty linens in public.”

At the end of the evening, Tom packs up his DVDs, and the three friends walk down the deserted street to his bus stop. “Things are getting a little better here,” Harry says. “We’ve all got mobile phones and email now, so we can keep in touch with the outside world.” Tom doesn’t seem to be listening. As he hops onto the bus, he offers—with a devilish grin—a seditious farewell: “See you after the insurrection!” □

— Part —

APE

— Part —

HUMAN

*A new ancestor
emerges from the richest collection of
fossil skeletons ever found.*



BY JOSH FISCHMAN
PHOTOGRAPHS BY BRENT STIRTON
ART BY JOHN GURCHE

Bones from a site called Malapa, near Johannesburg, South Africa, could represent the long-sought ancestor of the genus *Homo*. Paleoartist John Gurche reconstructed the face of the new species, named *Australopithecus sediba*, from the anatomy of a young male's skull, with no thought to how human or apelike his visage should appear. The result was something in between. "You have to let the morphology speak," says Gurche.





LEE BERGER IS STANDING IN A DEATH TRAP, SMILING.

It is a hole in the ground about 25 miles northwest of Johannesburg, in a ridged brown valley where herds of giraffes occasionally parade between stands of trees. The red-rock walls of the pit are higher than Berger's head, and steep enough in spots to make a scramble up, or down, rather daunting. Some two million years ago, the hole was a great deal deeper, with no possibility of escape for any creature that fell in. This accounts for the trove of fossils Berger is finding, which in turn accounts for his upbeat mood. He leans over a red boulder near the pit bottom, tracing a white-colored protrusion with his fingers. "It looks like part of an arm," he says. "That means we've found another individual."

The first two skeletons removed from the pit were a young adolescent male, 12 or 13 years old, and an adult female. Berger, a paleoanthropologist at the University of the Witwatersrand in Johannesburg, and his colleagues made the announcement in April 2010. The site, an eroded limestone cave called Malapa, is in a region already so famous for its ancient human fossils that it is often referred to as the Cradle of Humankind. Much of that reputation rests on finds from the early 1900s, back when South Africa harbored the best evidence for early human evolution, including *Australopithecus africanus*, at the time our oldest known ancestor. Beginning in the late



1950s, the epochal finds of the Leakey family in Tanzania and Kenya, followed later by Donald Johanson's celebrated discovery of the 3.2-million-year-old Lucy skeleton in Ethiopia, shifted cradle-bragging rights to East Africa, where they have remained ever since.

Lee Berger thinks the cradle is about to rock again. He believes Malapa may hold the key to one of the most significant, least understood chapters in the human evolutionary journey: the origin of the first species enough like us to be called human—a member of the genus *Homo*.

"This is where that story may have begun," he says, as he starts the climb out of the pit.

Josh Fischman wrote on bionics for the January 2010 issue of National Geographic. Brent Stirton photographed Timbuktu in January 2011. This is John Gurche's ninth contribution to the magazine.



Paleoanthropologists Lee Berger (far left) and Job Kibii confer while excavators search for bones near the Malapa cave. Skeletons from the site are “the Rosetta stone to the origin of *Homo*,” says Berger.

At an international gathering of anthropologists in Minneapolis this past April, Berger and his colleagues laid out arguments for why the Malapa species, known as *Australopithecus sediba*, may represent an intermediate form between the primitive australopiths and our genus, *Homo*. The evidence they point to includes an australopith’s little brain (with some curiously modern

features), apelike shoulders, and arms adapted to climbing in trees—attached to a bizarrely modern hand with the precision grip of a toolmaker. According to the researchers, the adult female’s foot presents an even odder melange; her mostly modern ankle is connected to a heel bone more primitive than that of *A. afarensis*—Lucy’s species—which is at least a million years older.

In a science known for its contentiousness, such a claim will surely not go unchallenged. But no one disputes that the Malapa fossils are unprecedented.

“It really is a jaw-dropping find,” says Carol Ward, a paleoanthropologist at the University



of Missouri who studies the evolution of apes and early hominins (a term for humans and other nonape primates; some researchers prefer the older term, hominid). “We have no other collection of fossil skeletons, until the Neanderthals just over 100,000 years ago, that are so articulated, so complete.”

The abundance and spectacular condition of the fossils have much to do with the peculiar geography of the place. Malapa, it seems, was both a water source that gave life and a trap that snuffed it out. Two million years ago, a cave-studded aquifer lay beneath an undulating plain of shallow, wooded valleys and rolling

hills. Some of the caves were open to the surface through steep entryways or vertical shafts stretching up to 160 feet. In wet periods, when the water table was high, animals could easily drink from seepage ponds near the surface. During drier times they would venture into the darkness of a hole, following the sound or scent of water—and risking a plunge down a hidden shaft. (The boy’s upper arm bones show fractures typical of a headfirst fall from a great height.)

“These animals had no choice. They needed water to survive,” says Brian Kuhn, a zoologist from the Johannesburg university—called Wits for short—who works at the Malapa site. After



death, their bodies would wash down even deeper in the cave system, becoming entombed within days or weeks in a single, thick layer of sand and clay, rather than a succession of thin layers, as would have happened had the sediments accumulated over months or years.

This raises the possibility, says Berger, that all the hominins—at least four are now known from the site—died weeks or even days apart, and therefore may have known each other in life. The rapid burial also caused their flesh to take longer to decompose, packaging the skeletons in death as they were arranged in life, right down to tiny bones of the hands and feet. Indeed, the rapid entombment may have preserved some of the skin itself, on top of the boy's skull and on the woman's jaw near the chin—something never before seen in a hominin fossil.


“Wow!” says Nina Jablonski, an anthropologist at Pennsylvania State University and author of the book, *Skin: A Natural History*. “The possibility of preserved australopithecine skin is massively cool.” What makes it so cool is the possibility of determining how these near humans reacted to heat. She is particularly interested in whether the alleged skin (or a fossilized impression of the skin, if that's what it is) might contain evidence of scalp and facial hair, and a high density of sweat glands.

Jablonski thinks such glands could be a precondition to the bigger brains long seen as a

DANGEROUS GROUND

Today Malapa lies on a slope above a grassy plain (above). Two million years ago water percolated through underground caves (art), forming surface springs in wet periods. In dry times animals seeking water in caves could fall through hidden shafts, their bodies later covered by sediments.





Death trap caves litter the region around Malapa, such as this one at Sterkfontein. This famous fossil site has yielded numerous *Australopithecus* remains, including a remarkable skeleton called Little Foot, still under excavation.



These skeletons from the Malapa site rank among the most complete finds in a science mostly defined by scattered bones. The adult female (at left) and young male may have been closely related. The remarkably well-preserved hand of the female shows the capacity to bring thumb and fingers together. With this precision grip, she could have used and made tools.

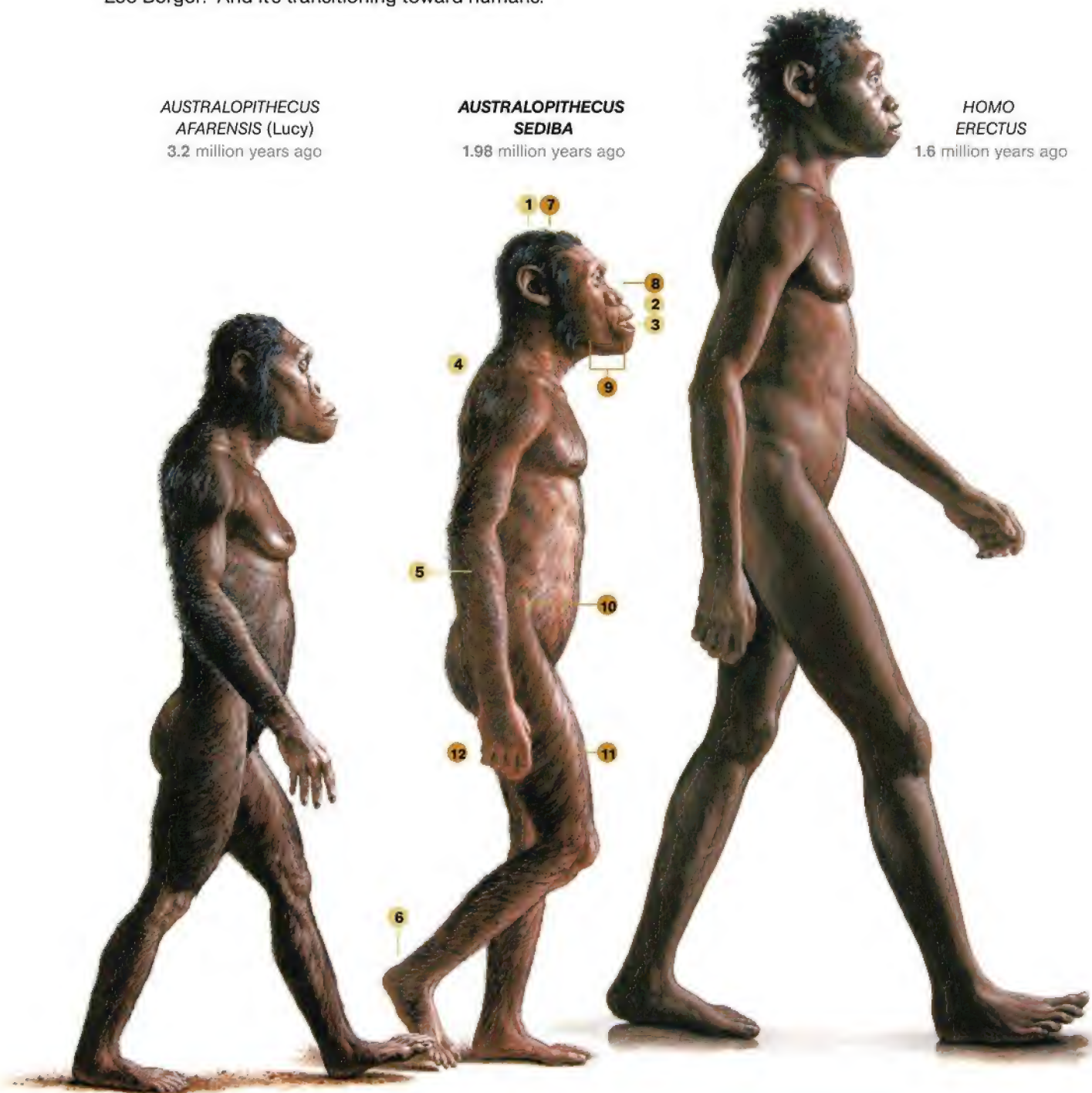
MIDDLE MAN

According to its discoverers, *A. sediba*'s odd blend of primitive and modern traits make it an intriguing candidate for the immediate ancestor of *Homo*. "It's the ultimate look at a species in transition," says paleoanthropologist Lee Berger. "And it's transitioning toward humans."

**AUSTRALOPITHECUS
AFARENSIS** (Lucy)
3.2 million years ago

**AUSTRALOPITHECUS
SEDIBA**
1.98 million years ago

**HOMO
ERECTUS**
1.6 million years ago



SIMILARITIES WITH AUSTRALOPITHS

- Small brain size **1**
- Long, high cheekbones **2**
- Primitive molar cusps **3**
- Small body size **4**
- Long upper limbs **5**
- Primitive heel bone **6**

SIMILARITIES WITH *HOMO*

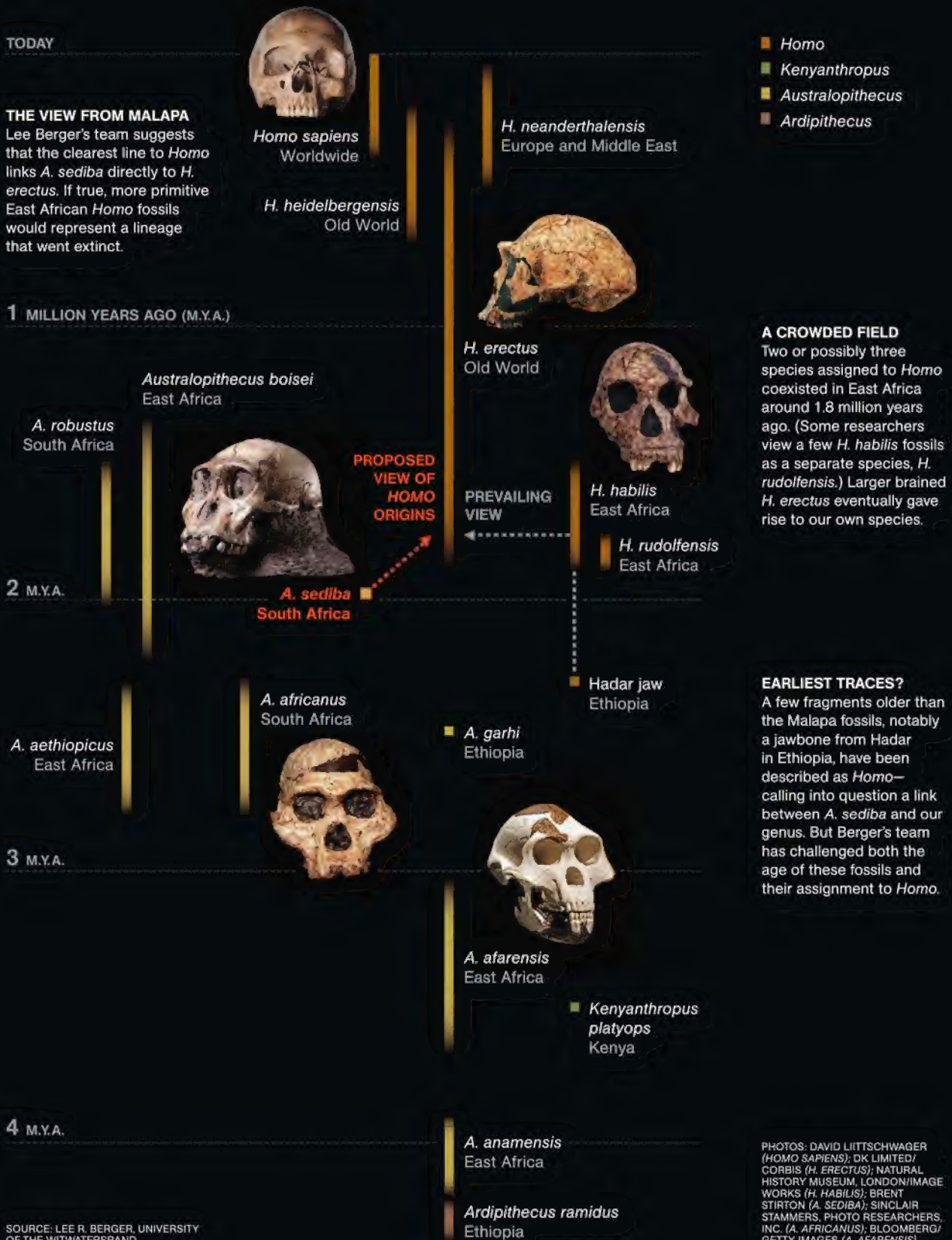
- 7** Front of brain reorganized
- 8** Projecting nose
- 9** Smaller teeth and chewing muscles
- 10** Hips less flared, similar to humans
- 11** Longer legs
- 12** Hand with precision grip



The skull of the young male *Australopithecus sediba* rests near the spot where he died, amid rocks he may have walked on in life.

MURKY BIRTH

The origin of *Homo* is a dimly understood stage in our evolutionary journey, and the view that *A. sediba* is the ancestor of our genus will not go unchallenged. One obstacle: fossil fragments also bearing hints of *Homo*, possibly half a million years older.





Lab technician Celeste Yates carefully prepares three connected vertebrae from the adult female *A. sediba* specimen. Finding pieces of the spinal columns joined together eliminates guesswork over how they articulated in life. Features of the spine, pelvis, and legs indicate an upright, two-legged gait.

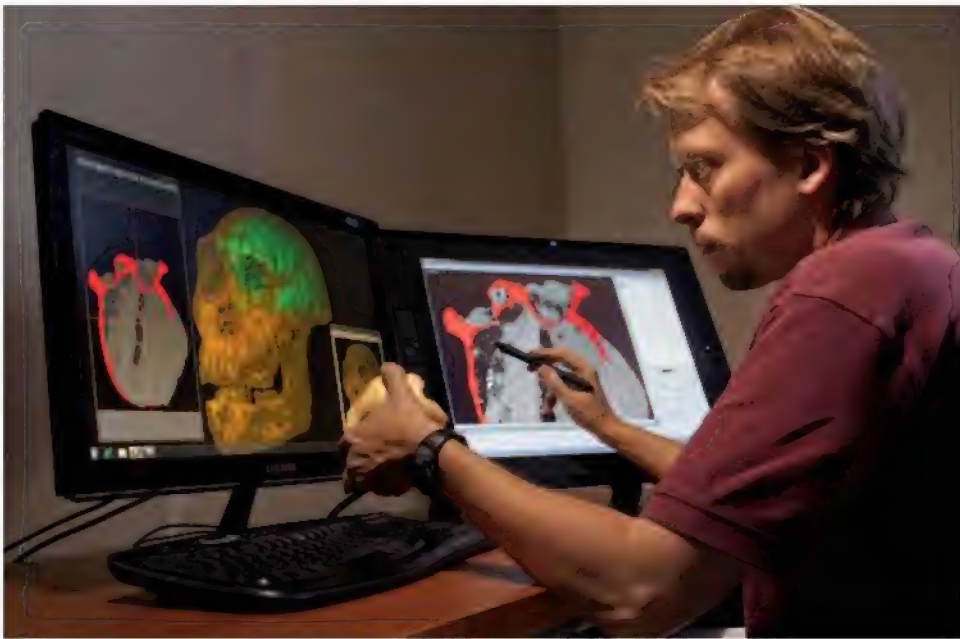
defining attribute of *Homo*. Chimpanzees, our closest living relatives, spend most of their time sheltered from the sun's heat by forest cover and have a limited ability to sweat. Our earliest ancestors also typically occupied woodland environments. But as the environment became drier around two million years ago, they began to forage in more-open grasslands—a problem for brains, which are notoriously vulnerable to heat. Bigger brains require even more cooling. A marked increase in the number of sweat glands and a reduction in body hair could have provided that, Jablonski speculates, in turn allowing for further brain growth as *Homo* began to use those bigger brains for toolmaking, planning, and other cognitively challenging activities.

So what about the brain of *A. sediba*? The question triggers another big grin from Berger. Its size is a chimplike 420 cubic centimeters—not at all unusual for something called *Australopithecus*. The shape, however, is. Together with Paul Tafforeau at the European Synchrotron Radiation Facility in Grenoble, France, Berger's team produced a series of ultrahigh-resolution images to create a virtual endocast: an impression of the boy's skull showing the

general contours of the outer brain layer.

"The frontal lobes on the two halves appear to be different sizes," notes Kristian Carlson, a paleoanthropologist at Wits who is reconstructing *A. sediba*'s brain. Pronounced asymmetry between right and left brain hemispheres is a hallmark of humans, because our cerebrum has become specialized, with the left side more involved in language. On that side Carlson sees hints of a protrusion in the region of Broca's area—a part of the brain linked to language processing in modern humans. But Dean Falk from the School for Advanced Research in Santa Fe, an expert on fossil endocasts, adds the caution that Broca's area is defined by specific creases in the brain, and "it would be quite a reach" to identify it based only on a bulge.

A. SEDIBA'S GREATEST PROMISE may lie in its power to illuminate the murky origins of *Homo*. The birth of our genus has long been a conundrum for paleoanthropologists, to say the least. Only a few scattered and fragmentary fossils older than two million years have been argued to belong to the genus. Then, around 1.8 million years ago, not one but two or possibly even three



Paleoanthropologist Kristian Carlson consults scans of the Malapa male's skull, revealing brain features never seen before in a hominin so ancient. Reflecting national pride in the find, artists (and castmakers) Mabote Boy Louw and Given Fortune Bongani Nkosi paint an evolutionary mural in Mamelodi township (right).

Homo species appear, mostly in East Africa. The smaller brained, more primitive ones are called *Homo habilis*, or “handy man,” a name given by Louis Leakey and colleagues in 1964 to specimens from Olduvai Gorge because of their association with the first crude stone tools. Some researchers group a few *H. habilis* specimens into a separate species, *Homo rudolfensis*. Then there is *Homo erectus* (the early African forms are sometimes called *Homo ergaster*)—larger brained, bigger bodied, more advanced, yet contemporaneous with little *H. habilis*.

Where did all these characters come from? Attempts to look deeper into the past only increase the frustration, says William Kimbel, a paleoanthropologist at Arizona State University and director of the Institute of Human Origins there. “There are only a handful of specimens. You could put them all into a small shoe box and still have room for a good pair of shoes,” he says. An upper jaw from Hadar in Ethiopia, found by Kimbel himself, is 2.3 million years old. A lower jaw from Malawi may be 100,000 years older, though the dating is uncertain. Some researchers would include a skull piece from Kenya of about the same age. That’s about it.

Enter the skeletons of *A. sediba*—as resplendently well preserved as those shoe box fossils are not. Anatomically, the species shows a mix of primitive and advanced traits. In addition to its long upper limbs, small brains, and primitive heel bone, its small body size and the shape of its molar cusps and cheekbones hark back to earlier australopiths, such as *A. africanus*, that lived in southern Africa between two and three million years ago. (Indeed, some researchers suggest that it might be a late form of that species.)

The long legs and that modern ankle are key elements on the human side of the ledger, says Darryl de Ruiter, a paleoanthropologist at Texas A&M University and part of the Malapa team. He also cites the surprisingly humanlike pelvis built for a fully bipedal stride; smaller teeth and chewing muscles; a projecting nose and some other features of the face; and that remarkable, precision-grip hand. These traits are enough for the team to propose it as the australopith species most likely to have given rise to *Homo*.

But which *Homo*? The team leans very cautiously toward *Homo erectus*, the species generally seen as the immediate forerunner of *Homo sapiens*. If this is so, then the smaller, mostly



East African forms now attributed to *Homo*, including Louis Leakey's original toolmaker *H. habilis*, would become a branch of the family tree that simply petered out. It is not the first time scientists have suggested these species could be evolutionary dead ends. But the Malapa fossils bring more clout to the debate.

"*Sediba* casts everything called *Homo* before *erectus* into question," says de Ruiter.

The biggest obstacle facing this challenge to the establishment view is the timing. If two-million-year-old *A. sediba* is indeed the true ancestor of *Homo*, how could it give rise to those even older fossils assigned to *Homo* in Bill Kimbel's shoe box? A fossil cannot be ancestral to something older than itself any more than a daughter can give birth to her own mother. One possibility is that the Malapa specimens represent a late stage of an enduring species that gave rise to *Homo* at an earlier date. But Berger's team questions whether that shoe box really contains any *Homo* fossils in the first place—after all, they're just fragments. Kimbel doesn't buy it.

"It's nonsensical to dismiss fragments, because fragments *do* tell you something," he says.

He points out that the upper jaw from Hadar has a short, broad, humanlike dental arch and flat snout, placing it firmly in the *Homo* genus—and it is at least 300,000 years older than *A. sediba*.

Berger's team, however, insists that Malapa changes the game. Articulated skeletons are far more than the sum of their parts: They prove that parts in isolation can be misleading. Think of the bits of *A. sediba* that look primitive, and the other bits that look modern, he says. The Hadar jaw, in the same way, might not accurately represent the rest of the creature.

"How can the Hadar jaw be misleading?" says Kimbel. "Either it shares features with later *Homo*, or it does not. Nothing in *sediba* can change that."

If the Hadar jaw really is *Homo*, says Berger, then perhaps its dating is wrong—a contention Kimbel disputes as vigorously as he supports the validity of his fossil.

The truth about *A. sediba*'s place in our ancestry may still be lying in the ground. "The beauty of a place like Malapa is that there are many more bones, and more individuals to come," Berger says. Ultimately the fossils, not the arguments, will carry the day. □

TRIP

Cruise to Antarctica

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EXHIBIT


INDIANA JONES AND THE ADVENTURE OF ARCHAEOLOGY

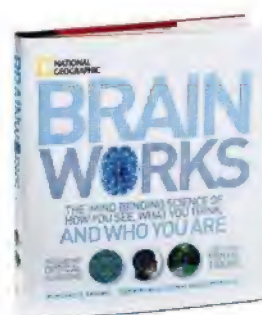
Everyone's favorite archaeologist takes you on a multimedia adventure in this traveling exhibit. Explore a vast collection of artifacts and movie props, including the idol (left) that Indy found in *Raiders of the Lost Ark*. At Canada's Montréal Science Centre through September 18. See indianajonestheexhibition.com.

APP


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Depedro *Nubes de Papel*

Nubes de Papel is the second album by Depedro, the solo project of Spanish singer and songwriter Jairo Zavala. This month download "Empty Fields," a song Zavala cowrote with Calexico's Joey Burns. It's a fresh take on Tex-Mex border music, infused with Iberian soul and lilting Spanish guitar. Visit natgeomusic.net/free to download.

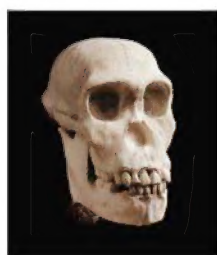
Feat of Clay Reconstructing ancient species begins with taking modern ones apart for paleoartist John Gurche. He crafted the *Australopithecus sediba* shown below and—with digitally added hair—on page 121. “Over the years I’ve dissected apes as well as humans, taking some 300 measurements each time.” Then he uses the measurements in his work. “For example, the ratio of eyeball to eye-socket size compares in chimps, bonobos, gorillas, and humans. Scaling to the body size of the creature, you know how big some other soft-tissue features should be.” Getting the figure’s expression right is harder. “I find myself staring at people,” Gurche says. “My wife has told me, ‘Stop anatomizing me!’” —Margaret G. Zackowitz



THE PROCESS

I start with bare bones.

It took 60 days for me to get *Sediba* up to final clay. I work from the deep to the superficial, basically doing a dissection in reverse. I’ve worked on this methodology for 25 years. It involves as much science as art.



Day 1 The skull is modeled from a high-resolution 3-D scan from the original *A. sediba* skull.



Day 15 Acrylic eyeballs are added. Markings on the bone guide sculpting of chewing muscles.



Day 40 *Sediba* likely used his mouth in food preparation. His mouth probably had strong musculature.



Day 53 Most of the clay is now applied. Adding soft tissue makes a big difference in expression.



Lip Service

A trusting visitor gets her lipstick touched up via the robotic arm exhibit at the American Museum of Atomic Energy in Oak Ridge, Tennessee (now the American Museum of Science and Energy, where a smaller version of the exhibit is still on display). The same kind of device was also employed by atomic scientists at the nearby Oak Ridge National Laboratory to handle radioactive materials.

This photo was likely taken for—though not published in—the *Geographic's* January 1954 story “Man’s New Servant, the Friendly Atom.” Using a mechanical hand, notes one caption in that article, a “scientist can even turn a screwdriver or write her name. Mechanical limbs reproduce her movements exactly.”

—Margaret G. Zackowitz

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PHOTO: VOLKMAR WENTZEL, NATIONAL GEOGRAPHIC STOCK

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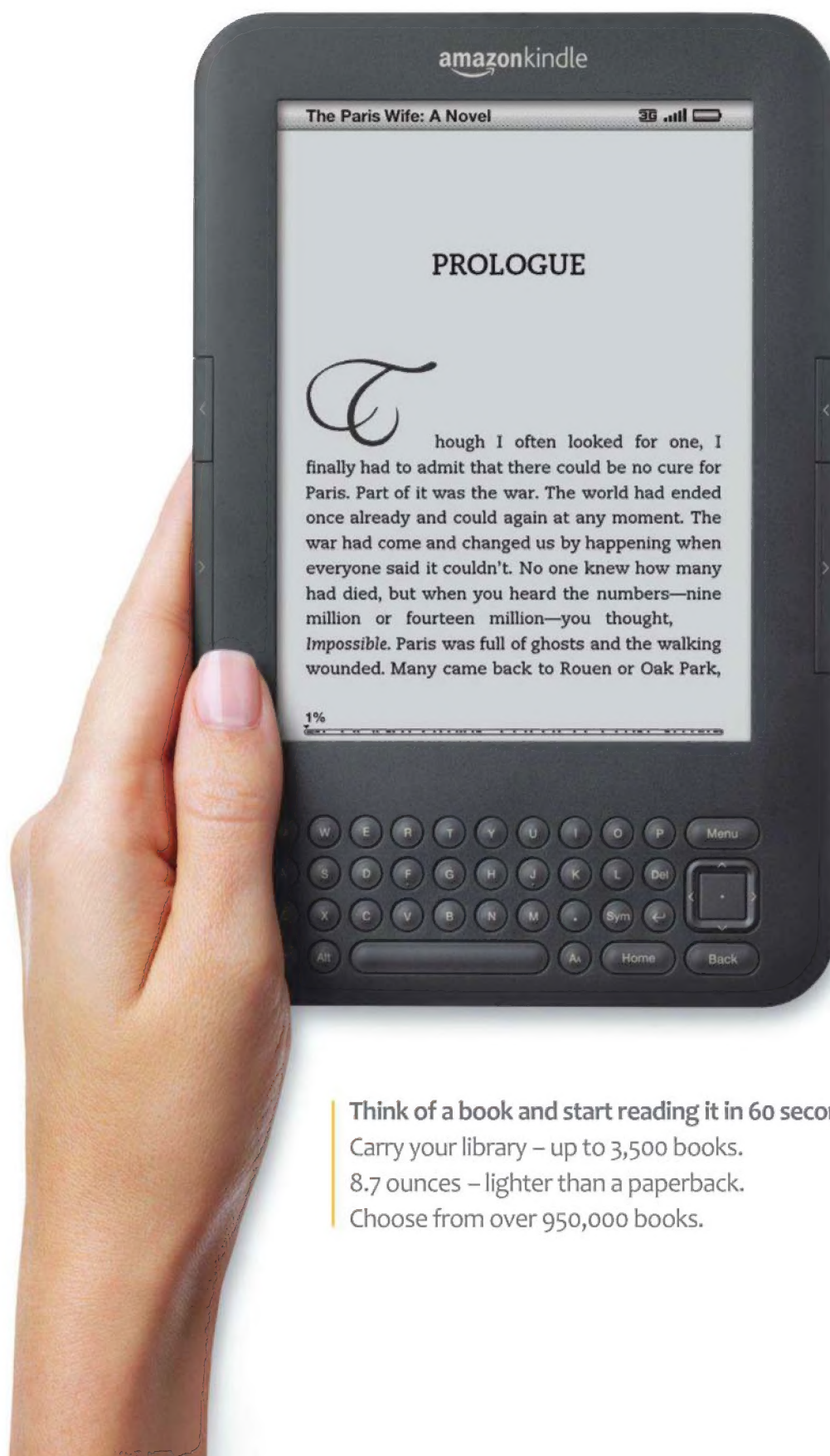


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